DEVELOPING SKILLS FORESIGHTS, SCENARIOS AND FORECASTS

GUIDE TO ANTICIPATING AND MATCHING SKILLS AND JOBS VOLUME 2

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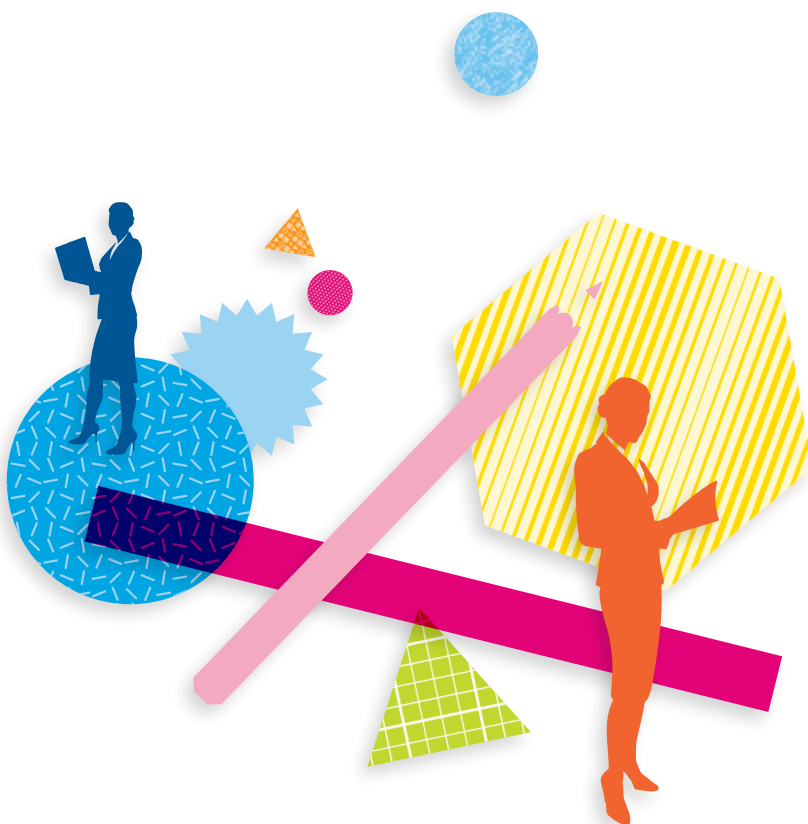Printed in Italy

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GUIDE TO ANTICIPATING AND MATCHING SKILLS AND JOBS VOLUME 2

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FOREWORD

In a context of dynamic and complex labour markets, gathering intelligence on current and future skill needs can support better matching of training and jobs, which is of paramount importance for every country in the world. In recent years, better understanding of labour market needs and skills matching have featured high on the policy agenda of many countries, driven by both rapid technological advances and global competition. Skills matching can also help reduce unemployment, particularly among young people. It helps build a better life for individuals by improving employability, social mobility and inclusion.

The European Union (EU) places great emphasis on skills anticipation and better matching. The Europe 2020 strategy and, in particular, the Agenda for new skills and jobs, recognise that anticipation and matching approaches and methods can help develop a skilled workforce with the right mix of skills in response to labour market needs, in a way that promotes job quality and lifelong learning. The EU Skills Panorama, launched in 2012, supports the effort to provide better data and intelligence on skill needs in the labour market.

The tripartite representation of International Labour Organization (ILO) Member States agreed that countries that have succeeded in linking skills to gains in productivity, employment and development have targeted skills development policy towards three main objectives:

- matching supply to current demand for skills;
- helping workers and enterprises adjust to change;
- building and sustaining competencies for future labour market needs.

Skills matching is a complex and dynamic process involving multiple stakeholders making multiple decisions at different times: individuals and their families, as they make decisions regarding their own education and training; education, training and labour market policy makers, as they decide on the configuration of education and training systems, employment policies and investments; training institutions, as they make decisions on the type and content of the training courses to be delivered; and employers, as they take decisions on how to train workers and utilise skills.

Jobs are changing rapidly and individuals are also changing their skill sets, either through education and training or through their work and life experience. Education and training systems, in particular, have a key role to play in ensuring that opportunities are provided for all individuals to develop their skills continually in a lifelong learning perspective, enabling them to adapt to rapidly changing labour market requirements and conditions.

Given the complexity and dynamics of the process, perfect matching between skills demand and supply is neither feasible (especially in rapidly changing labour markets and economies) nor necessary, given the fact that many people can do many different jobs and many jobs can be done by people with different skill sets. However, it is important for policy makers to be aware of the importance of reducing the risk of creating large skills gaps that undermine the employability of individuals and impede the productivity of enterprises and the growth of economies.

International experience suggests that a comprehensive labour market information system is the backbone of any education and employment strategy, but no single methodology can generate sufficient knowledge of labour markets to avoid or minimise skills mismatch. The right mix and complementarity of different methods is essential for a reliable and comprehensive overview of skills demand and matching.

For developing and transition countries, skills matching and anticipation is becoming an even more complex task given their particular socio-economic conditions, weak institutions, capacities and governance systems. Many developing countries have limited labour market information and more effort and investment is needed to build robust information systems. At the same time, even limited evidence can be better, and more efficiently used, with proper methodological tools and analyses.

To respond to these challenges, the European Training Foundation (ETF), the European Centre for the Development of Vocational Training (Cedefop) and the International Labour Office have joined forces and combined expertise and geographic coverage to develop a compendium of methodological guides on anticipation and matching of skills supply and demand:

- Volume 1: how to use labour market information.
- Volume 2: how to develop skills foresights, scenarios and skills forecasts.
- Volume 3: what works at sector level.
- Volume 4: what is the role of employment service providers.
- Volume 5: how to develop and run an establishment skills survey.
- Volume 6: how to carry out tracer studies.

The six guides complement each other. They include both qualitative and quantitative approaches, and advocate strong social dialogue and institutions conducive to better understanding the skills needs of tomorrow. They target professionals, policy makers, research commissioners, social partners and experts who need an overview of how different anticipation and matching methodologies can generate reliable labour market information and how information and evidence can be analysed and used for the development of policy interventions or adjustments in education and employment strategies.

The compendium brings together state-of-the-art international good practice and experience worldwide. The most common approaches used for skills matching and anticipation in different economic and country contexts are reviewed, and their potential and methodological shortcomings for generating reliable data and information are examined. They serve as reference material for readers to explain the scope, added value and limitations of diverse methodologies. The guides also provide insight into how the results of different methodologies can be analysed to provide recommendations and policy formulations.

Any feedback from readers and users of the guides is very welcome, particularly regarding how the next editions could be improved or made relevant to their circumstances and policy dilemmas, how they are used in different countries and contexts, including especially in bringing stakeholders together, and which topics could be added in the future to complement the current compendium.

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Purpose of skills foresighting and forecasting

Foresighting and forecasting support decisions in areas which involve long lead times, such as education and training, and long-term labour market planning. Skills anticipation offers early warning of evolving skill mismatches, allowing sufficient time for action to counteract them. Individuals, firms and education and training providers, who have to make decisions about the kinds of education and training required for the future workforce, need to assess future prospects carefully, looking to fill information deficits and avoid future imbalances and mismatches:. Anticipating the future is not straightforward, yet it allows the identificaiton of current trends and strategies and their likely implications in the future.

The main rationale for skills anticipation is that labour market failures make a case for public intervention. Generating information for labour market actors ensures a better match of skills acquired through education and training, an important element for economic policy decision-making. Ideally it is undertaken within a broader approach, with other elements of economic development, where investment in education, training and quality of jobs is part of the process.

Approaches: foresighting versus forecasting

The guide focuses on mid- to long-term anticipation, ranging from five up to 20 years. These foresight and forecasting approaches are applied either at national level covering the whole economy or – in the case of foresights – at sector level for one or more sectors within the economy.

Our review from various countries shows that there is no single, simple model that could be applied universally. However, several principles and approaches can be identified that have been successful. Common

experience in data and institutional requirements are reported.

While foresights and quantitative skills forecasts have similar goals in informing decision-makers and stakeholders about likely future outcomes and their probable consequences, they differ in the way they are implemented, their requirements in terms of inputs, and in the types of outputs that they can generate.

Qualitative foresights require less formalised (data) inputs and are easier to set up initially. They do not require extensive data series or quantitative modelling of labour market relations. Foresights depend on the inputs from key experts and stakeholders and on the way which they are combined in methodology. Foresight is a visionary tool which provides incentives for participating stakeholders to come up with the future they want and commit themselves to the implementation of the vision. Foresight is a highly interactive tool of social dialogue with representatives of the private sector.

Quantitative skills forecasts offer a consistent and detailed picture of future developments by sector, occupation, qualification or skills. They are more demanding in terms of the availability of adequate labour market data, both in quality and in the data series length. Building and interpreting quantitative models takes time and expertise, even if they are based on established principles. Based on international experience, the guide suggests combining (modules generating) supply by qualification, demand by sector, occupation, and possibly skills or qualification.

Both qualitative and quantitative elements can be mixed to develop a skills anticipation model or method that is suitable for a country's or region's purpose. Often missing elements of quantitative skills forecasting can be substituted by simplified procedures or assumptions that can be based on qualitative methodology. A methodology of skills anticipation that

is mainly based on qualitative approaches can be supported by quantitative inputs at various stages and settings.

Implementation

The guide emphasises a hands-on approach. It discusses the steps that need to be taken in foresighting and forecasting approaches. In this context, we do not only discuss issues of methodology but also of implementation processes.

Skills anticipation will only be successful if it is embedded into a structure in which the results are developed, discussed and used with the various stakeholders and decision-makers. It is not only the development and the instruments of generating forecasting or foresighting results that are important, but also networks and institutions that work with the data, feed back into them, and participate in the development of the (initial) discussion or evaluation of results.

Case studies and descriptions of approaches from across the world are included to emphasise the importance of learning from others. They also show how the basic concepts and instruments need continuous adaptation to the particular circumstances of the individual situation in specific countries.

The guide sees several success factors, both for foresights and also for forecasting: successful skills anticipation depends on identifying clear and realistic goals; it should be embedded into an institutional framework which includes identifying and engaging key stakeholders; and to broaden the use and the usefulness of skills anticipation, dissemination of results across various channels should become increasingly important. Tools and instruments should be chosen according to the infrastructure and resources. If the data infrastructure is good, quantitative skills forecasting might be considered; qualitative foresights are less dependent on well-established and long-term data collections. Skills anticipation should not be a one-time exercise but a sustained, long-term effort that is repeated regularly to allow both for the development of a methodology of generating the skills forecast or foresight and an understanding of how to use the results.
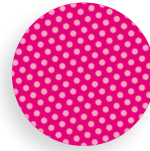
Introduction

We live in a rapidly changing and uncertain world. Individuals, firms, and education and training providers have to make decisions about the kinds of education and training that will offer the best returns. Peering into the future is not straightforward, yet there is rising demand for information on potential developments. Long lead times on investment decisions such as education and training mean that it is necessary for all those who are making such choices to assess future prospects carefully. This includes those concerned with macro-level policy in these domains, as well as individuals, organisations and institutions making more personal choices. Help is needed to fill information deficits and avoid future imbalances and mismatches.

Foresights, skills anticipation and forecasting should not be seen as only necessary in high-income countries. Though such countries usually have easier access to funds for these types of projects and more developed statistical data available, the basic problem addressed by the activities within this guide remain important at all stages of development: to acquire an understanding of current and future evolution on the labour market, and to support the development of the right mix of human capital within a nation.

The main rationale for skills anticipation is avoiding labour market failures. This makes a case for public interventions to ensure a better match of the skills acquired through education and training and those that are necessary to succeed in the labour market and to ensure better lives for individuals. Skills anticipation is therefore an important element for economic policy decision-making. Ideally it is undertaken within a broad approach, with other elements of economic development and where investment in education, training and quality of jobs is viewed as part of the process.

Skills are crucial to prosperity. They contribute to economic growth both directly, through increased productivity, and indirectly, by creating a greater capacity of workers and firms to adopt new technologies and ways of working and spurring innovation. Conversely, skills shortages and mismatches between the supply of and demand for skills lower the potential for growth and may lead to a waste of resources.

Skills also improve the lives of individuals. The economic benefits of higher levels of initial education are well documented. Higher levels of attainment are associated with lower rates of unemployment and higher earnings. Research strongly suggests that upskilling – measured as the share of post-secondary graduates in the population – plays a key role in countering the long-term trend of growing inequality in earnings. Adult education and training also have a significant positive impact on workers' productivity and wage levels. In contrast, having to support poorly-skilled people who are under- or unemployed can be very costly for governments (OECD, 2011; ILO, 2008).

Education has a positive impact not only on economic performance but also on social outcomes. Adults with higher levels of education are more likely to report that their health is good, and they tend to have a greater interest in politics and higher levels of interpersonal trust. Skills – both cognitive and non-cognitive – play an important role in empowering individuals to follow healthy lifestyles and to be active citizens. The strong positive relationship between education and health outcomes has also been documented for developing countries and emerging economies (ADB, 2008). These benefits accrue to society as a whole, as they reduce social costs – for example, in health expenditure – and foster social cohesion.

Foresights and skills anticipation: Part A

The future is uncertain but, for policy goals, we need to try to understand what will happen. Foresight techniques and methods play a crucial role in revealing future developments. They help to deal with uncertainty and provide insights for identifying future changes and needs. In education, anticipation of skill needs is essential to meet future skill requirements in the economy and society. Even though some have argued that systematic anticipation of changing skill needs is impossible, with sophisticated approaches it is possible to fill information deficits and help reduce future imbalances and mismatches. Foresight can help those concerned with policy-making in anticipation of skill needs to make better decisions and support planning. It is a helpful tool for education policy planning in times of rapid change. It allows engagement with a broad range of stakeholders in meaningful discussions about not only what we think education might become, but also what we want education to become.

The concept of foresight is introduced in the first chapter of Part A which provides understanding on how foresights can be used within skills anticipation. This chapter details when and how this methodology is useful while chapter 2 introduces the various foresight methods and procedures. Those interested in using and implementing the methodology should read chapters 3 and 4 that intend to show how foresights can be implemented and adapted to local needs. The annex provides examples of implementation of foresights that have been used in various country settings.

Skills forecasts: Part B

Quantitative skills forecasts offer a consistent and detailed picture of future developments by sector, occupation, qualification or skills. Models that provide quantitative forecasts of future supply and demand on the labour market show – similar to foresight – how future outcomes can be generated to guide current decision-making. This allows policy-makers to understand mid- to long-term developments and to react towards expected imbalances.

Chapter 5 provides an overview of the use and usability of skills forecasting, the choice on duration and when to use quantitative forecasting. Chapters 6 to 9 provide detailed elements and methods to be used. Some specific issues, such as the problem of technological change and qualification requirements, the identification of imbalances, thoughts on indicators and issues of regional forecasting are explored in Chapter 10. Chapter 11 discusses some specific examples of skill forecasting.

Foresights versus quantitative skills forecasts

While foresights and quantitative skills forecasts have similar goals in educating decision-makers and stakeholders about likely future outcomes and their probable consequences, they differ in the way they are implemented, their requirements in terms of input, and also in the types of output that they can generate.

Both qualitative and quantitative elements can be mixed to develop a skills anticipation model or method that is suitable for a country's or region's purpose. Often missing elements of quantitative skills

forecasting can be substituted for by using simplified procedures or assumptions based on qualitative methodology. A methodology of skills anticipation that is mainly based on qualitative approaches can be supported by quantitative inputs at various stages and settings. Some examples are discussed in Part A.

Objectives

This guide aims to provide countries which are starting to develop systems of skills needs anticipation with information on different aspects and methodologies of foresights, as well as ways to model and forecast skills needs. The main purpose of the guide is to address the following key questions: why undertake skills foresighting and forecasting, what can be done and how to proceed? It is not the intention to imply that foresighting and quantitative skills forecasting must be used together: in many cases only one of the two is used. However, elements of foresighting will normally be included in the assumptions underlying quantitative models, and making quantitative models more explicit through foresight techniques might improve their forecasts. Further, foresights always benefit from many different inputs, as we will show below. Quantitative forecasts, if available, will always help to form better foresight studies, as they provide a structured form of information that the outcomes of the foresight can reflect upon.

The overall aims of the guide are to help countries to develop such systems by providing useful, practical and independent advice based on good practice from other countries. It aims to support awareness and the learning process from the experience of many other countries across the world (both developed and developing) that can be used in setting the vision and designing and implementing a country's own specific systems. It should serve as a reference and toolkit.

Experience of various individual countries makes clear that many different approaches to skills anticipation have been applied across the world. It is obvious that there is no single, simple model that could be applied universally. The cases considered in this study suggest that it is possible to draw out lessons from examples of good practice as well as some methods that can be inspirational when adopting a particular approach in a country: the guide provides information on what works
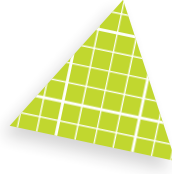
in a particular context. It is possible to extract the main success factors common to most cases presented here. Although some of the approaches and ideas discussed come from a developed country's perspective, they are also readily adaptable to specific circumstances of developing countries on a case-by-case basis.

The guide focuses on mid- to long-term (5 to 20 years) skills foresight and forecasting approaches applied either at national level covering the whole economy or – in the case of foresight – also at sector level covering primarily one or more sectors within the economy (see annex). It aims to be a self-standing and self-explanatory document. It is practice focused with a didactic step-by-step approach.

The reader

This guide is designed primarily for sponsors of skills anticipation activities that can initiate or promote the foresight processes and foster implementation of the necessary structures. It also intends to advise a broader range of stakeholders including policy-makers, education and training providers, public employment services, social partners, research and specialist organisations and other stakeholders that may be involved in such activities.

Part A: Foresight

Chapter 1.
Foresight and skills

1.1. What is a foresight?

The term 'foresight' is nowadays widely used, increasingly so over the last two decades. Even though foresight, mostly a qualitative approach, is quite often confused with forecasting, extrapolating or planning, it does not have the same meaning. Foresight could be defined as a systematic, future intelligence-gathering and medium to long-term vision-building process aimed at identifying opportunities and areas of vulnerability to assist present-day decision-making [1]. The key element in foresight activities is that 'they are action-oriented, in the sense that the final aim is to influence, shape and act upon the future. […] Foresight processes and outputs should be oriented towards contributing to, facilitating or guiding the decision-making process' [2]. The chain of foresight activities is shown in Figure 1.

Figure 1. Foresight activity chain

Information	Reality
Analysis	Mapping the current state
Interpretation	Understanding of the state
Perspectives	Possible future development
Outputs	What should be done
Strategy	What and how do we do that?
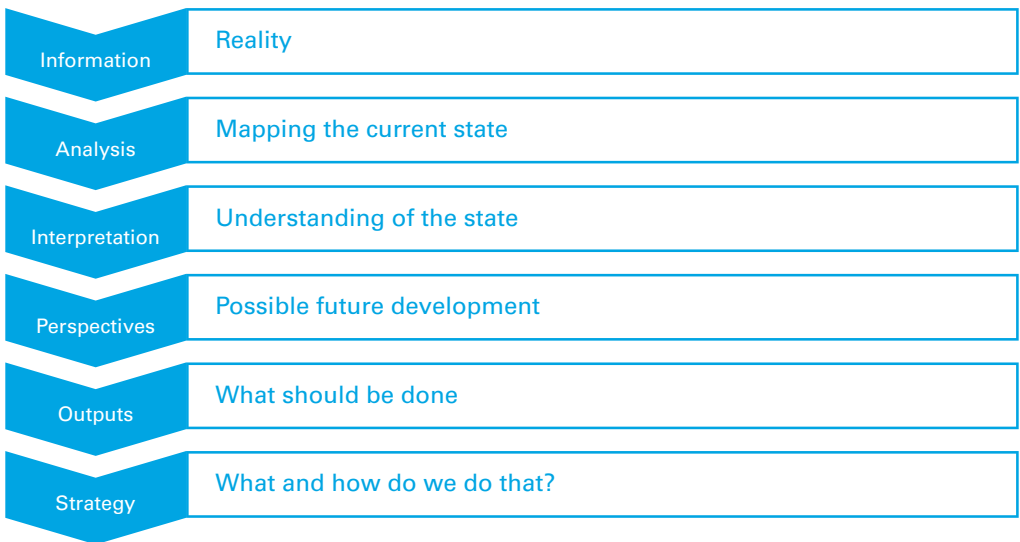
Source: Authors based on Valenta (2012) and Conway (n.d.).

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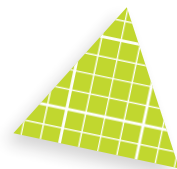
[1] JRC-IPTS, *For-Learn online foresight guide*: an A to Z of foresight http://forlearn.jrc.ec.europa.eu/guide/A1_key-terms/foresight.htm [accessed 24.6.2014].

[2] JRC-IPTS, *For-Learn online foresight guide*: action-oriented http://forlearn.jrc.ec.europa.eu/guide/A1_key-terms/action.htm [accessed 8.5.2014].
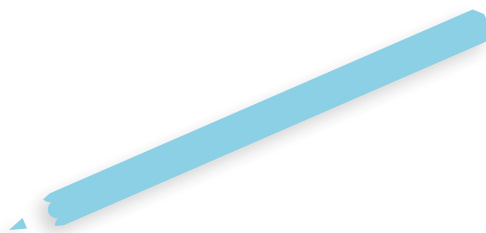
Forward-looking thinking is vital for policy planning to be able to meet future challenges proactively, including the area of future skill needs. 'Foresight enhances such thinking by gathering anticipatory intelligence from a wide range of knowledge sources in a systematic way and linking it to today's decision-making' [3].

Typical objectives of foresight exercises include one or more of the following:

(a) informing policy-making so that decisions taken by key actors in the commissioning body include more awareness of longer-term developments and how these are liable to interact with current policy decisions. This can involve gathering intelligence on possible longer-term developments and how these may interact with the policy decisions made today, or providing alerts on major future risks and opportunities. Often a foresight exercise will be stimulated by the need to take a particular decision;

(b) building networks that bring together people from different sectors and institutions involved in shaping the future of a particular topic: they are brought together to work on their visions and assessments of the future. The purpose of this is to help them become better able collectively to understand the challenges and opportunities that they are liable to confront, and the strategies and objectives that others might pursue;

(c) developing capabilities throughout a region or organisation, along with a 'foresight culture'. The aim here is for people with a variety of backgrounds to be able to define and embark upon their own foresight activities and create their own foresight networks;

(d) building strategic visions and creating a shared sense of commitment to implement the measures associated with these visions among foresight participants [4].

Foresight is not a one-shot activity but a part of continuous evaluation. The results of every foresight should be reflected in strategy and implemented in relevant areas. However, assessment and subsequent analysis should follow implementation of the strategy, to ensure feedback and contribute to the intended development (Figure 2).

At first, most foresight initiatives focused on technology and its social and economic impact. New-generation foresights have dealt also with demographic change, health, social welfare, transport, energy, environment and climate change, community development, culture, human resources, and skills anticipation and education [5].
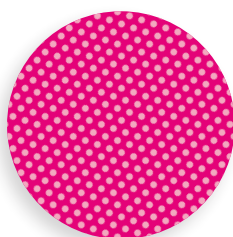
[3] JRC-IPTS, *For-Learn online foresight guide*: home http://forlearn.jrc.ec.europa.eu/guide/0_home/index.htm [accessed 8.5.2014].

[4] JRC-IPTS, *For-Learn online foresight guide*: why do foresight? Objectives http://forlearn.jrc.ec.europa.eu/guide/1_why-foresight/objectives. htm [accessed 8.5.2014].

[5] JRC-IPTS, *For-Learn online foresight guide*: scoping an exercise: major decisions http://forlearn.jrc.ec.europa.eu/guide/3_scoping/dec_ scope.htm [accessed 8.5.2014].
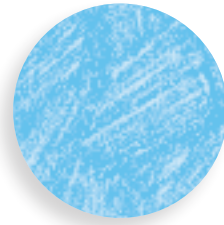
Figure 2. Foresight as part of a continuous process
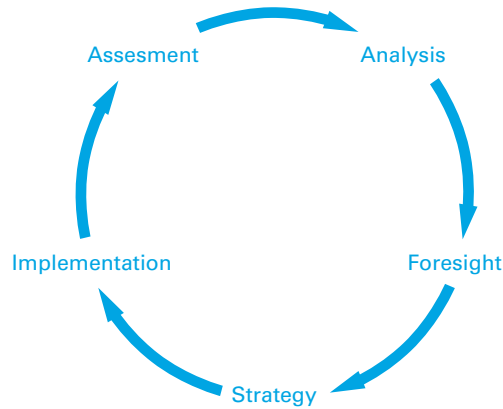
Source: Translated from Valenta (2012, p. 17).

1.2. Skills anticipation in foresight activities

The main rationale for skills anticipation is to help meet future skill needs by providing policy-makers and other actors with relevant information. Approaches to skills anticipation are important for economic policy decision-making. Ideally they are undertaken within a broader foresight approach with other elements of technology and economic developments, where the investment in education/training and the changes in structure and quality of jobs are viewed as part of the process. Various country cases considered here illustrate, however, that many broader approaches have resulted in less specific outcomes for skills policies, while isolated skills anticipation activities tend to have more limited success.

In its relatively brief history as a formalised policy tool (foresight started to evolve in the second half of the 20th century), foresight has undergone a rapid evolution and has been adapted to a diverse range of policy domains. The generational model of the evolution of foresight was developed to classify an increasing number of foresight activities (Table 1) (Miles et al., 2008). It is not meant to illustrate transitional development but all of the approaches described coexist today and are used to address different types of issues. Therefore, it is not possible to assign any time references to particular generations of foresight; it is up to the foresight practitioner to select the appropriate approach given the nature of the issues to be addressed. The third and fourth generation forms of foresight, with their broad stakeholder involvement and their holistic approach to policy issues, are ideally suited to addressing skills issues.

Table 1. Generations of foresight

	First generation	Second generation	Third generation	Fourth generation	Fifth generation
Scope	• Policy-makers • Subject area experts	• Policy-makers • Subject area experts • Industry	• Policy-makers • Subject area experts • Industry • Society representatives	• Organisation leaders • Subject area experts • Industry • Society representatives • Policy-makers	• Occurs within specific organisations • Organisation leadership • Subject area experts • Industrial and professionals partners
Domain	• Science and technology	• Science and technology	• Science and technology • Social policy	• Science, technology and innovation • Variable configurations depending on participants	• Science, technology and innovation • Variable configurations depending on participants
Inputs	• Economic and scientific benefits of technology	• Economic, social and scientific benefits of technology • Potential product development • Markets	• Economic, social and scientific benefits of technology • Potential product development • Markets	• Social and scientific benefits of technology • Strategic plans • Dependent on participants	• Social and scientific benefits of technology • Strategic plans • Dependent on organisation
Outputs	• Funding priorities for technological development	• Funding priorities for technological development	• Funding priorities for technological development • Public policy • Education and training needs	• Resource allocation for technological development • Organisational strategies • Public policy	• Resource allocation for technological development • Organisational strategies • Innovative services and products

Source: Georghiou et al. (2008) cited in Thayer (2012).
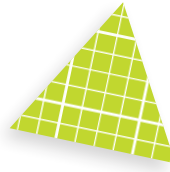
Skills have been a feature of foresight from early days. Initially only higher qualifications were involved because of the connections to public research and development (R&D) and science and technology (S&T) policies. As the target of foresight has expanded to include a broader range of social policy concerns, all levels and types of education have been addressed: formal, non-formal and informal. Since education is a primary tool for structuring social futures, it is hard to justify omitting it from any large-scale foresight activity. However, the worldwide mapping of foresight activities carried out by international organisations such as the European Union (EU) suggests that skills are included in few foresight programmes (16% of all foresight programmes in the world specifically addressed issues relating to education) (European Commission, 2009).

Foresight might be a helpful tool for skills policy planning in times of rapid change. Its emphasis has shifted from supporting top-down interventions aimed at directly influencing skills produced to less direct influence of various stakeholders to make better informed decisions (employers, education and training institutions, students, workers). This has occurred in countries with a more developed foresight culture (generally most developed countries). The various current approaches to foresight provide a powerful toolbox for foresight practitioners to find an ideal method suitable for the issues to be addressed and the outcomes anticipated. A shift from one-off foresights to regular exercises of envisioning future needs has occurred in recent years.

A foresight exercise will lead to a number of tangible and intangible outcomes, and can also bring other benefits on various levels. However, foresight has its limitations and cannot be perceived as a panacea.

1.3. Foresight story

As an example of the motives, policy challenges, and the role of a skills foresight exercise, and its possible benefits, below is a fictional case study inspired by up-to-date worldwide experience.

1.3.1. Bellandia's foresight programme

Bellandia is a medium-size emerging economy. Over the past five decades the country had undergone rapid industrialisation based on inward-looking strategy. It had a highly regulated planned economy at that time, with production intended mainly for its internal market and, to lesser extent, for similar countries engaged in a regional south-south cooperation. The economy was based on traditional sectors such as agriculture, natural resource extraction or energy production, with a growing share of construction, metallurgy and chemical industry. Over the years heavy industry production became the main contributor to GDP. The industrial sector also became the main employer after the primary sector (agriculture, natural resource extraction). Education and training were developed to provide skills that served industry needs. Given that there was little pressure on innovation, and that changes in industrial production were slow, there was relatively stable demand for skills, and education and training could be easily adjusted.

Due to internal political changes resulting from an adverse economic situation and changes in the international environment (dissolution of the regional cooperation bloc) in the early 1990s, Bellandia revised its development strategy and opted for closer integration into world markets. Opening the economy exposed Bellandia to intensified global competition. More liberalised markets for goods, services and investment helped to increase competitiveness and

productivity but also changed the traditional structure of the economy. On the down side, the changes revealed some already latent social problems (large informal sector) and triggered new ones. New challenges arising from technological change, population growth and social innovation resulted in pressure for revision of public policies: industrial, social, healthcare, education. The country has experienced an unprecedented growing mismatch between industry needs for skills and those skills provided by education and training: this was identified by growing youth unemployment. Modernisation of the education and training system was urgently needed.

The government was aware of the fact that Bellandia was in transition from an industry to a service and knowledge-based economy and the country was facing unprecedented challenges. Following consultation with several international institutions, the government initiated development of a new national economic strategy called Plan B, aiming to outline where Bellandia wished to be in the mid to long term. The debates between the Ministry of Economy, the Ministry of Labour and the Ministry of Education ensured the skills mismatch issue was included on the agenda for the plan.

Since it was recognised early that the education and training system was unable to respond quickly to changes in the labour market, the initial idea was to develop a tool that would help to anticipate what skills will likely be required in the future rather than just recognising current skill needs. The Ministry of Education was authorised to launch a skills anticipation programme. Economic conditions, however, did not

allow it to allocate sufficient national financial resources for the programme, so a grant was offered under the condition of shared financing, allowing the ministry to launch the programme. Since there was little experience with such programmes, implementation was assigned to the newly created Project Management Agency, which had project implementation for public authorities as its declared mission. The Ministry of Education, as the sponsor, outlined the programme and instructed the Project Management Agency to start the feasibility phase. The programme had to embrace all key sectors of the economy and their contribution to GDP and employment. Soon it was realised that the country lacked adequate research capacities and expertise, which required it to hire experts and consultants from abroad. Further, there was little experience with participative social dialogue, weak institutions at sectoral level, and weak cooperation among stakeholders. A quick survey among employers, however, revealed their willingness to participate in the programme. A data audit carried out by international experts showed there was an inadequate data infrastructure for applying quantitative methods or building a skills forecasting model. After collecting available information on developing skills anticipation systems (including studying guides published by international institutions and good practice examples) and considering the local context, the programme focus shifted to foresight approaches as the most adequate way of addressing the identified challenges.

The proposed foresight programme had to address two key questions: how new economic and social trends change the nature of working tasks and the demand for

related skills; and what are the implications for education and training and other stakeholders. It was proposed to consider nine key growing sectors of the economy and their development in the mid to long term (5–10 years). The Project Management Agency assessed and summarised the potential benefits of the foresight programme for the stakeholders (the sponsor, the Ministry of Education, other relevant ministries, employers, education and training institutions, students) and prepared a feasibility report for the sponsor. The Ministry of Education considered available resources and the potential benefits of the proposal and instructed the Project Management Agency to proceed with the programme.

The Project Management Agency started to set up the organisational structures for the programme; it also began to clarify the key programme design elements, such as a closer specification of objectives, outcomes, scope, time horizon and the expected duration of the exercise. The objectives were adopted from the feasibility report. Outcomes were further specified to be customised and delivered to the sponsor for strategic decision-making as well as for education and training institutions, sector employers, and the public (students, career advice). The outputs had to cover two time horizons: five and 10 years. The scope of the programme included the delivery of specified outputs to stakeholders and their dissemination to the public but not the implementation of results, which was left for stakeholders. The programme duration was estimated to be 14 months. Special attention was given to the engagement of stakeholders. Six groups of stakeholders were identified and classified based on their potential interest and the likely impact of the programme on them: large employers, SMEs, research institutions, professional or sectoral associations, education and training institutions, and public

authorities including the sponsor. There were different levels of involvement. Only the key stakeholders were represented in the steering committee of the programme but most were to be included in expert activities. All of them, including the general public, were the target group for the dissemination activities. Soon it was realised that some groups of stakeholders were not appropriately represented. For example, the SMEs, which represent the bulk of employment opportunities, did not have corresponding associations that could speak for them. The same was true where sectoral institutions did not exist at the time the programme was starting.

The methodology outlined in the feasibility phase was further developed and refined with the assistance and consultation of international foresight experts. This resulted in the definition of the best ways to find answers to key programme questions, with a stated method mix and parameters. Once all the programme elements (objectives, outcomes) and the methodology were clarified, they were combined into a coherent design for the programme and became a basis for programme planning. The Project Management Agency engaged international experts and the country's top researchers in these activities. Three phases were planned.

The first comprised collection, collation and summary of available information. It started with a meta-analysis of megatrends, international challenges and the national environment, followed by a general industry analysis and a preliminary analysis of drivers of change in a specified sector. The main methods used were literature review and semi-structured expert interviews. Collation and summary gave the information obtained a structure and form and reduced its volume.
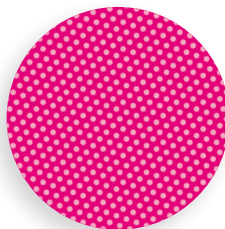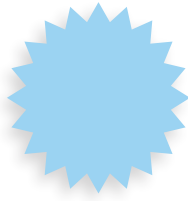
The foresight phase comprised translation and interpretation of the summarised information to produce an understanding of its implications for the future. Given the national cultural background, the main topic and programme objectives, and the nature of possible methods, the Delphi method was chosen as it is evidence-based, and enables the identifcation of unexpected events, and appropriate stakeholder engagement. The number of experts involved was estimated to be 200. The phase was designed to produce a description of the main drivers of change for the sector, market opportunities and threats, new core tasks likely to be required in the future, existing tasks that will be more in demand, tasks likely to disappear and future skills needs (sector-related, cross-sectoral). The outputs also included how skills can be formed (initial education, on-the-job training) and what can be done about it today. This phase resulted in an understanding of what can (or cannot) be done for the future.

The third phase included verification of foresight results in the steering committee, roundtables with decision-makers (sectoral and national level) and surveys in stakeholder communities (mail- and website-based) for those not directly involved in previous activities.

Although the Project Management Agency employed project managers with international experience in large projects, managing the foresight programme was a difficult task. Managing stakeholder expectations proved demanding because some presented surprisingly diverging views, not identified before, in the steering committee. For example, the sponsor expected very detailed results for strategic planning for a limited budget, while employers were interested mainly in the immediate future. The debates about refocusing the programme delayed key activities, which were also affected by unavailability of experts and by other unexpected events.

Once the main activities had been completed, the foresight programme could deliver its results to stakeholders, with outcomes customised for different stakeholder target groups. The future job maps (including skill profiles) developed for nine sectors were delivered to stakeholders/employers in the corresponding sectors. Recommendations for curriculum changes were delivered to education and training institutions and the Ministry of Education. Education and training providers (especially the private ones) were interested mainly in outdated skills and new skill needs in the mid-term future, while the Ministry of Education was concerned with the long-term overview for proposed curriculum reform. The general public, including students and career advisors, were given profiles for the jobs that would be most wanted in the future. The dissemination of results was through reports, public presentations (for professionals as well as the general public), media campaigns (press, TV, radio, website-based tools), distribution of printed materials (such as leaflets to schools and communities) and even mobile phone applications.

The programme was effectively able to meet stakeholder expectations. The Ministry of Education was able to use the long-term (10-year horizon) results for the preparation of the curriculum reform, introducing more flexible ways of developing school curricula. The programme also provided a significant input (sectoral trend outputs) into the debate about developing the Plan B that could bring Bellandia closer to a knowledge-based economy.

The programme also had several immediate positive side effects: it established networks with stakeholders that can promote the creation of sectoral institutions, it reviewed the data infrastructure for monitoring the labour market and skills, and it improved the country's evaluation culture. The Project Management Agency gained considerable experience in managing the

foresight programme. Now government structures can benefit from this experience when considering similar programmes; for example, the Ministry of Education is considering a foresight programme to identify research priorities.

The programme can yield more benefits in the long term. Follow-up activities are necessary to take full advantage of the foresight programme outcomes. The Ministry of Education had already announced its intention to monitor the impact of the foresight programme (changes in curricula against development of skills gaps). Using the results requires further investment: financial resources are necessary to reform education and training and for training teachers as well as to introduce new curricula or teaching methods. It also requires true willingness to cooperate from other stakeholders. The main contribution of the foresight programme is in making available the information that can guide today's stakeholder decisions and lead to a desirable future.
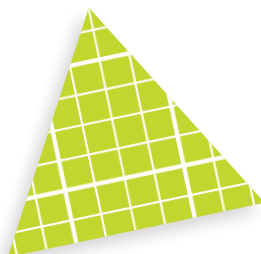
Chapter 2.
Comparative review of foresight and scenario methods

In this section we provide a detailed description and typology of foresight methods and approaches of foresight application. The emphasis is on explaining how these methods are used, what the features are, and what are the pros and cons of using particular methods. Most frequently used methods are accompanied with an example from a selected country. Choosing an adequate method is critical, though choice often appears to be based on what is fashionable or which method practitioners are familiar with (UNIDO, 2009). Therefore it is necessary to be able to distinguish among particular methods, determine which is appropriate to use, and decide how this method should be applied. No one particular method can be the solution for all problems; usually a combination of methods has to be applied and the context of a particular country must be considered: one size does not fit all. Different problems and contexts require different configurations of foresight approaches. It is necessary to be familiar with foresight methods, but more important is to know the specifics and economic, institutional and social background of particular countries. This means that evaluation of foresight efforts is not just a matter of examining the efficiency of the activities but must also consider their effectiveness in promoting change to meet the challenges confronting us.

2.1.   Categories of foresight methods

Foresight exercises offer many ways to gather information regarding possible future outcomes. Depending on the aim and nature of the results aspired, foresight methodology can be split up into several categories: exploratory and normative methods and supplementary methods. The latter include techniques which are not directly considered as foresight methods, but in some way support them in achieving their goal. This category comprises SWOT analysis, literature and statistics reviews, focus groups, and brainstorming.

2.1.1.   Exploratory methods

Exploratory methods start from the present with an attempt to see where events and trends might take us by exploring 'what if?' scenarios [6]. This means that 'exploratory methods start […] with the pre-conditions, beliefs and social or technological possibilities which already exist' (Magnus, 2012). Among typical techniques in this category are the Delphi method, scenarios or cross-impact analyses.

2.1.2.   Normative methods

Normative methods start with a vision of a possible or desirable future and work backwards to see if and how this future might be achieved, or avoided, given the existing constraints (skills, resources, technologies, institutions). Backcasting or morphological analyses are representative of this category.

Limited available evidence on which of these approaches is better and under which conditions suggests that normative methods are more effective where a widely shared vision already exists, and where foresight can then develop a strategy for how to achieve it; where no consensus on the vision has yet been achieved, exploratory methods may be more useful [7].

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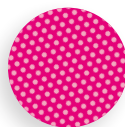
[6] JRC-IPTS, *For-Learn online foresight guide*: methodology: exploratory versus normative methods http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_explo-norma.htm [accessed 8.5.2014].

[7] JRC-IPTS, *For-Learn online foresight guide*: methodology: exploratory versus normative methods http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_explo-norma.htm [accessed 8.5.2014].

Figure 3.   Scheme of exploratory methods

Starting at the present, and ask what could happen if this event happened?

Different

futures

resulting from

different stories
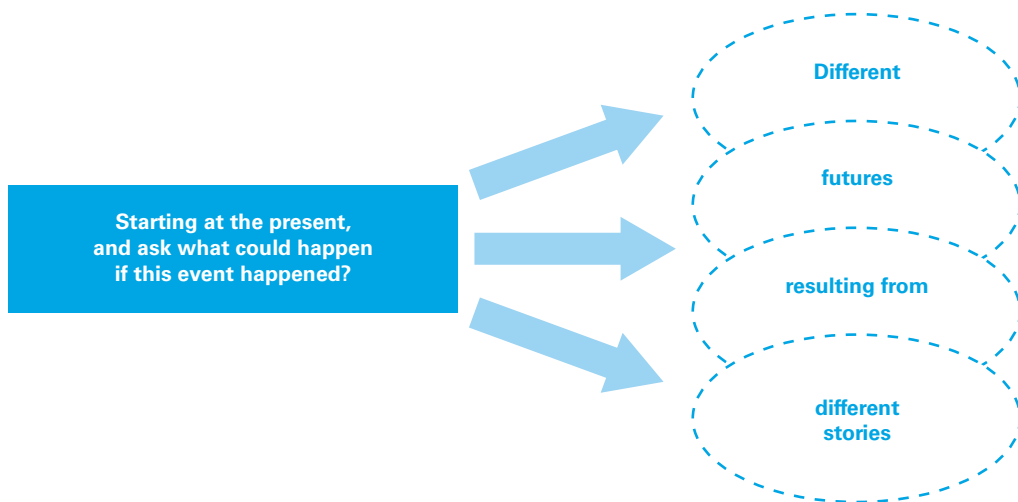
Source: Authors, based on the *For-Learn online foresight guide*: exploratory versus normative methods.
http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_explo-norma.htm [accessed 8.5.2014]

Figure 4.   Scheme of exploratory methods

Present

What we

want to

achieve.

Desirable future
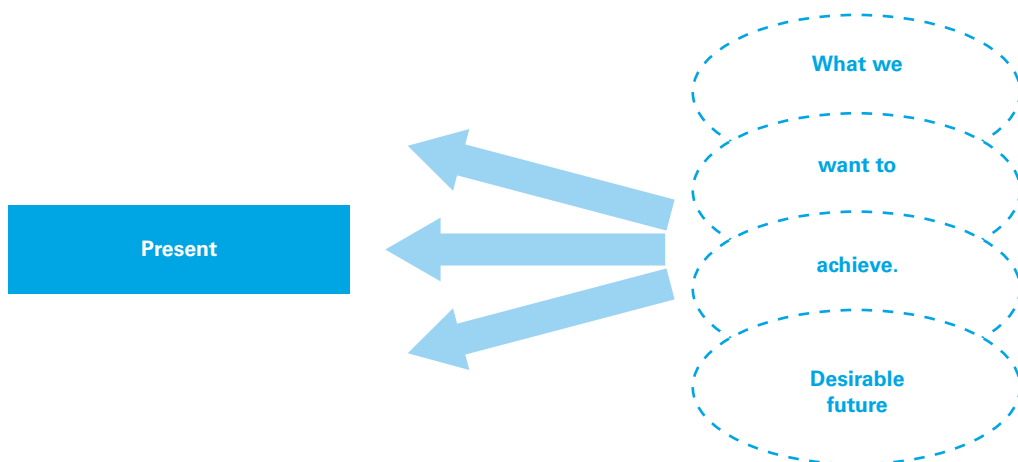
Source: Authors, based on the JRC-IPTS, *For-Learn online foresight guide*: exploratory versus normative
methods. http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_explo-norma.htm [accessed
8.5.2014].
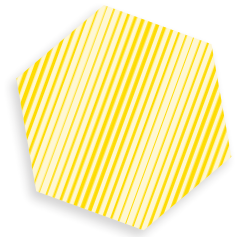
2.1.3. Other categories

Another way to classify methods is by considering their ability to gather or process information based on evidence, expertise, interaction or creativity. These attributes are the building blocks of the foresight diamond (Popper, 2008). The foresight diamond (Figure 5) does not imply the combinations of methods mentioned, but shows which attributes prevail in a particular method. The foresight diamond describes methods from the perspective of how they are created and developed and which attributes are determinants of a particular method being applied. For example, creating scenarios is considered as a creative activity; therefore it is close to the peak 'creativity' at the foresight diamond, even though the inputs are mostly 'evidence'-based. The foresight diamond acknowledges the core activity when processing the method, not the inputs or outputs of a particular method.

The closer the method to a peak of the diamond, the more it is affected by a particular attribute. Some methods can be considered as mostly evidence-based, such as literature and statistics reviews, whereas some are mostly focused on creativity, as with scenarios. In the middle of the diamond are methods whose results are created as a mixture of other attributes. Particular attributes overlap and combine in different proportions in each method.

Foresight methods can also be categorised as qualitative, semi-quantitative and quantitative methods.

The current trend in foresight is to apply a mixture of different approaches; it is broadly accepted that foresight activities cannot be completely dominated by purely quantitative methods and their results. Quantitative approaches often apply qualitative elements and qualitative approaches discuss and provide insight into the meaning of the numbers which are the results of quantitative methods (see also Part B on quantitative methods and models).

Qualitative methods are often employed where the key trends or developments are hard to capture using simplified indicators, or where such data are not available. These methods 'are often used to provide meaning to developments and observations. Such interpretations tend to be based on particular views, beliefs and knowledge which may be difficult to corroborate since methods provide a lot of room for creative and subjective thinking' (European Commission, 2009, p. 72).

'The second category comprises semi-quantitative methods, applying mathematical principles to quantify the opinions of experts' (European Commission, 2009, p. 72). This approach combines both qualitative and quantitative methods and allows presentation of numerical outputs from someone's opinions or views. This type of 'translation' of qualitative views and inputs also allows the use and mix of qualitative inputs into quantitative models (see here especially Section 8.4).
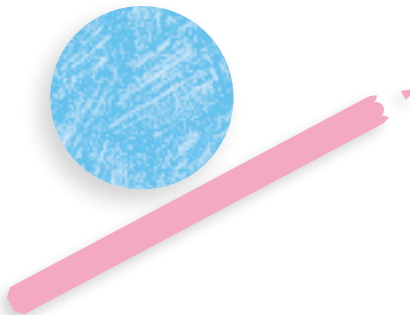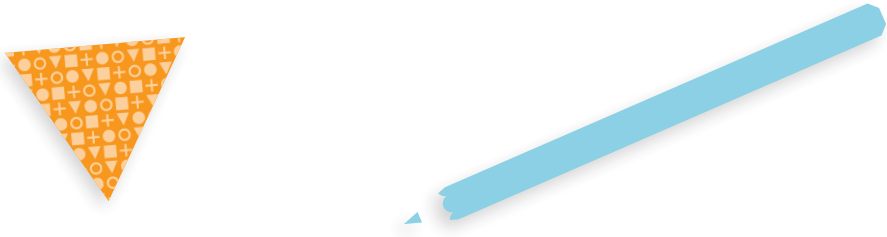
Figure 5.   Foresight diamond

Creativity

Scenarios

Backcasting   SWOT analysis   Brainstorming

Expertise

Roadmapping   Delphi method   Focus group

Expert panel   Morphological analysis   Horizon scanning

Interaction

Cross-impact analysis

Literature and statistics review

■ Exploratory m.
■ Normative m.
■ Supplementary m.

Evidence
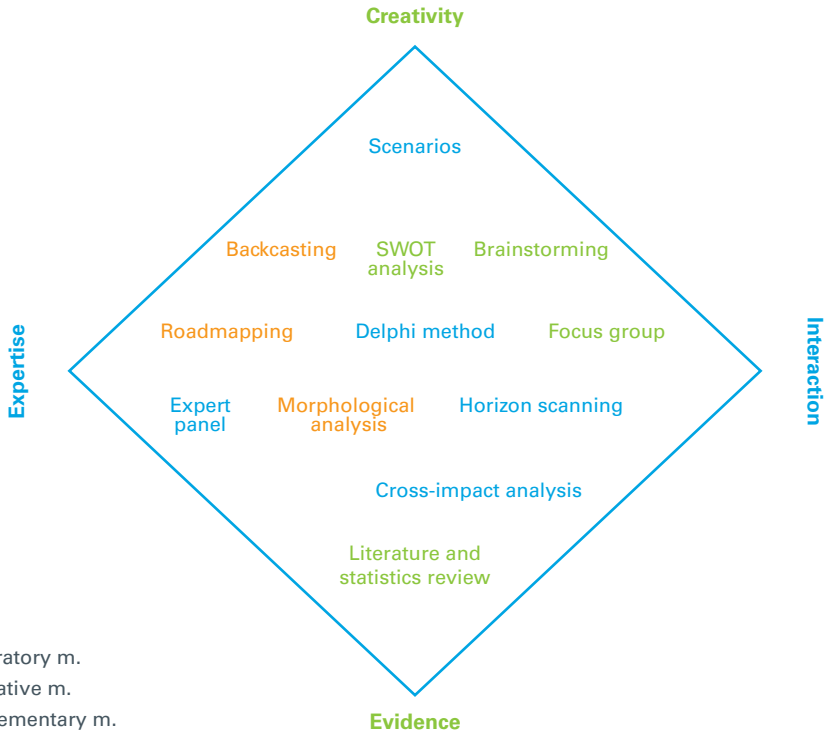
Source: Adapted from Popper (2008).

These methods 'are often used to monitor measurable variables and apply statistical techniques to process and analyse the often called "hard data" or indicators' (European Commission, 2009, p. 72). Quantitative skills forecasting, as described in Part B, is an example of these quantitative models.
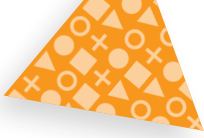
2.2. Foresight methods

There are many foresight techniques which researchers may choose and combine; this section describes a few in more detail. As identified in the case studies (see annex) the methods used most often in skills anticipation are the Delphi method, expert panel, scenarios, literature and statistics review, brainstorming and SWOT analyses. Other methods described in this section may also be suitable for skills anticipation in some country contexts but their use is not so common.

According to research undertaken by the European foresight monitoring network (European Commission, 2009), the methods mentioned above are also those that are mostly used in foresight activities, though not only for anticipating skill needs. The survey revealed that in the more established democracies of Europe and North America, stakeholders prefer face-to-face forums, thus they prefer methods such as expert panels and scenarios. By contrast, in new democracies and in Japan, more anonymous methods, such as the Delphi method, are often used (European Commission, 2009, p. 39). Experiences of different countries make clear that many approaches to skills anticipation have been applied across the world; there is no single, simple model that could be applied universally. Any single method is not usually used by itself but is complemented or supported by other methods or used in foresight 'packages'. To achieve desired outputs, combinations of methods have to be applied, where the output of one method serves as input for another. The emphasis in this section is on describing the most frequent methods used in foresight of skill needs and their features and specifics. These methods are divided into three categories: supplementary methods, exploratory methods and normative methods.

2.2.1. Supplementary methods
2.2.1.1. *Literature and statistics review*

When starting to think about the future, we need to achieve an understanding of the past and the present. One of the methods most used for this is a literature and statistics review, which is usually done at the start of a foresight project. This 'is not a foresight method as such, but rather an essential background activity or a first step in any foresight exercise' ([8]). A literature and statistics review is part of the process rather than a stand-alone method but it is a key process which involves observation, examination, monitoring and systematic description of the technological, sociocultural, political, ecological and economic contexts (Georghiou et al., 2008). Through such a review, knowledge can be accumulated and raw data converted into information. It aims at broad exploration of all major trends, issues, advances, events and ideas across a wide range of activities. It is often based on desk research and involves a wide variety of sources, such as newspapers, magazines, internet, television, conferences and reports. Sometimes it can prevent us from 'reinventing the wheel', because we have an opportunity to learn from and build on what others have done, as with the literature and statistics review used within the SENAI model in Brazil (Box 1). (More information about SENAI, the National Service for Industrial Apprenticeship can be found in the annex.)
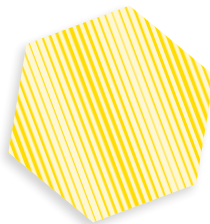
([8]) EFP, *For Learn*: methods: analysis: environmental scanning http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/analysis/environmental-scanning/ [accessed 25.6.2014].
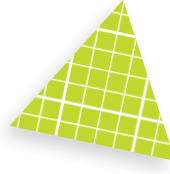
Box 1. Literature review: example of Brazil

Within the SENAI foresight model in Brazil, identification of new professions and roles emerging in other countries signals possible changes in the labour market. It identifies and learns from the occupation structures of other countries to anticipate which setting may be more likely to emerge in Brazil. This drives appropriate education and training responses. The methodology is based on research of secondary data sources covering general and sector and/or occupation studies conducted in other countries and involves three stages:

1. literature review to identify sector general and/or occupation studies conducted in selected countries. Australia, Canada, New Zealand, the UK and the US are used because they produce studies on occupation change and their occupational classifications are compatible with the international standard classification of occupations (ISCO) and the Brazilian classification of occupations (CBO);

2. comparison with existing occupations in the CBO for the sectors studied. This comparison considers work tasks in each occupation, as described in CBO, and work activities of occupations described in studies from other countries. The comparison classifies identified occupations as emerging, evolving or stable. The definition of the US Bureau of Labour Statistics was adopted for the concept of emerging and evolving occupations. Emerging occupations include tasks, skills and knowledge that are completely new; they may not be present in existing classifications. The tasks in evolving occupations include changes which may involve expanding or reducing tasks. Stable occupations are those that do not display changes;

3. detailed description of emerging, evolving and stable occupations that contains a set of aspects related to job content, skills and other requirements for performing these occupations. Secondary data sources provide reasons and/or hypotheses for classification of these occupations.

Source: Cruz Caruso and Bastos Tigre (2004).

A literature and statistics review should be part of a foresight exercise as a first step to obtaining a broad understanding of the issues. It must then be complemented with other methods such as scenarios and backcasting. Literature and statistics reviews have limitations (Table 2).

Table 2. Pros and cons of literature and statistics reviews

Advantages	Disadvantages
• provides an understanding of existing knowledge • can reveal major trends, issues or weak signals • method is desktop-based and so not too expensive	• requires time and research skills • must be complemented by other methods • could be underestimated and some signals may be missed • very limited perspectives

2.2.1.2. *SWOT analysis*

SWOT (strengths, weaknesses, opportunities and threats) analysis is not a foresight approach per se but can be used to provide inputs in foresight activities. It is not usually used by itself but is complemented by other foresight techniques, such as scenarios, Delphi surveys or expert panels. SWOT analysis can be used in tandem with brainstorming.

SWOT analysis is an analytical tool which helps to identify the main internal (strengths and weaknesses) and external (opportunities and threats) factors that may shape the reality (now or in the future). It can be used to develop a vision for a country/region/sector taking into account its strengths/weaknesses and opportunities/threats; or it can be used once the vision is already available to develop an institutional or business strategy for how to achieve the vision, taking into account the strengths/weaknesses and opportunities/threats of institutions or businesses.

Figure 6.   SWOT matrix

Strengths	Weakness
What are your advantages? What do you do well? What relevant resources do you have access to? What do the others see as your strengths?	What could you improve? What do you do badly? What should you avoid?
Where are the good opportunities in front of you? What are the interesting trends you are aware of?	What obstacles do you face? What is your competition doing? Is changing technology threatening your position? Do you have debt or cash flow problem?
Opportunities	Threats

Source: Adapted from JRC-IPTS, For-Learn online foresight guide: methodology: main methods: SWOT analysis
http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_swot-analysis.htm [accessed 12.5.2014].

SWOT analysis is often presented as a 2 x 2 matrix, summarising significant internal and external factors influencing strategies or possible futures. A set of questions needs to be answered in every particular quadrant to create such a matrix. It is usually prepared by an expert team using a variety of data sources (UNIDO, 2009).

A SWOT analysis is based on facts or expert opinions. The SWOT matrices help assess the probability and impact of factors where a scoring system can be used to provide a hierarchy of the importance of factors. Factors that score highly on both probability and impact require special attention in strategy formulation [9].

(9) JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: SWOT analysis http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_swot-analysis.htm [accessed 12.5.2014].

Table 3.   Pros and cons of SWOT analysis

Advantages	Disadvantages
• simplicity and flexibility • looking at the problem from a different perspective • opportunities can be exploited • the possibility to overcome weaknesses	• inadequate definition of factors • oversubjectivity in generation of factors • no suggestions for solving disagreements

Source: JRC-IPTS, For-Learn online foresight guide: methodology: main methods: SWOT analysis.
http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_swot-analysis.htm [accessed 12.5.2014].

2.2.1.3.   *Brainstorming*

Brainstorming belongs among creative methods and is often used at early stages of foresight activities, usually prior to scenario building or within SWOT analysis. Brainstorming as a method encourages group thinking and supports the generation of ideas. By encouraging individuals to discuss their own ideas, brainstorming is a powerful tool which may help to increase the group's ownership of the result, prevent conflict and achieve consensus. Brainstorming has to follow basic principles, if it is to be done correctly:

(a) no criticism and judgements. To encourage creativity and improve the value of ideas, all ideas are presented and accepted without any negative comment or negative evaluation;

(b) all opinions are equal. All participants should feel free to present their ideas, regardless of their status or position in the social hierarchy. Nothing is considered as undesirable;

(c) quantity exceeds quality. Generating as many solutions as possible to tackle defined problems is the required output of this technique;

(d) evaluation after discussion. To prevent a distortion or prioritisation of some ideas, evaluation should be done after the brainstorming. It is recommended to wait a couple of days for this (Potůček, 2006).

Effective brainstorming sessions involve seven to 12 participants. There are examples of using brainstorming in the latter phases of a foresight process, as is shown by the case highlighted in Box 2.
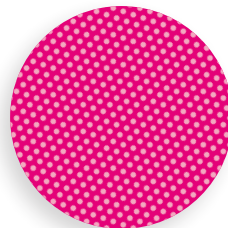
Box 2.   Brainstorming: US example

Brainstorming is often used in the initial phases of foresight projects to gather a wide pool of ideas and to identify main future trends and/or key issues that should be in the scope of further research in the next stages. It may be also used as a means of assessing and interpreting the results in a later stage of the process. This is how it was used by the Institute for the Future (IFTF) based in the US during their Future work skills 2020 project. After the pieces of intelligence were gathered, while drawing on IFTF's previous foresight exercises and their 'signals methodology', a group of experts was brought together to participate in the brainstorming exercise. They were experts from various fields and with diverse professional backgrounds. Their task during brainstorming sessions was to identify key drivers of change and how these will shape future skill requirements. In the next step, the outcomes were further analysed and filtered and the final six key drivers and 10 skills areas for the next decade were determined.

Source: IFTF (2011).

This example is an exception, because brainstorming is usually used before the foresight process, for example prior to scenario analysis. The results of brainstorming are not used separately, but are part of the assessment process [10].

Table 4.   Pros and cons of brainstorming

Advantages	Disadvantages
• brings new ideas on how to tackle a particular problem • free thinking encourages creativity • problems can be defined more clearly as new questions arise • brainstorming helps to reduce conflicts	• the importance of the moderator is often underestimated • sometimes the ideas produced are unworkable • criticism often appears and 'kills' creative ideas

Source: Adapted from JRC-IPTS, For-Learn online foresight guide: methodology: main methods: brainstorming. http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_crea_brainstorming.htm [accessed 12.5.2014].

2.2.1.4.   *Focus group*

A focus group supports the generation of ideas and encourages group thinking. 'A focus group is a form of qualitative research in which a group of people are asked about their perceptions, opinions, beliefs, and attitudes towards' [11] issues of interest. The main distinction between brainstorming and a focus group is that the purpose of brainstorming is mainly to generate ideas, whereas a focus group concentrates on improving, validating or complementing existing ideas. Participants in a focus group are encouraged not only to express their own opinions, but also to respond to other members and questions posted by the facilitator [12]. Brainstorming must have ground rules, whereas a focus group is more open-ended, though both methods bring together people in an effort to gain their ideas and opinions.

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[10] JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: brainstorming http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_crea_brainstorming.htm [accessed 12.5.2014].

[11] Wikipedia http://www.cse.lehigh.edu/~glennb/mm/FocusGroups.htm [accessed 25.6.2014]

[12] Focus groups or similar techniques are also often used in the context of quantitative forecast. In evaluating and discussing detailed results with key stakeholders in a focus group setting, the necessary qualitative background and feedback can be generated that help to improve quantitative models (see also Section 2.2 on foresight methods).

For a focus group, it is necessary to emphasise:

(a) defining the purpose: this should be clear and specific to avoid being too broad and general. The objectives of a focus group are either validating or clarifying findings or filling information gaps;

(b) establishing a timeline. It is necessary to identify the participants, develop questions, locate a site and gather materials for the session;

(c) identifying participants. First, it should be determined how many participants are needed (usually 6--12, it is better to keep the number of participants low) and who will be suitable ones. Participants may be all from one field or it could be a combination of different types of stakeholders. Identifying participants should be carefully planned to create a non-threatening environment;

(d) generating the questions. The focus group may last from one hour to one day but usually does not take more than a couple of hours; therefore the emphasis should be put on a limited number of principal questions. Questions should be open-ended and move from the general to the specific. Sometimes it is appropriate to send relevant materials or even distribute the questions to participants in advance, so they have time to get familiar with the topic and all issues.

(e) selecting the facilitator: this is an essential role. The facilitator should keep the discussion on track and make sure every participant is heard.

The focus group session should be well organised; all equipment and materials should be prepared and time should not be exceeded. The meeting should be summarised, the summary analysed and the final report should be created. Careful and systematic analyses of the discussions provide information on how the discussed issue is perceived by the group and perhaps what could be done better or improved. The advantages and disadvantages of focus groups and brainstorming are the same.

2.2.2. Exploratory methods
2.2.2.1. *Expert panel*

Expert panels are widely used in skills foresights to stimulate sharing knowledge and ideas among experts. Panels usually consist of about 10--20 experts but may involve many more if the discussion is well structured and occurs in fairly small groups. Panels are useful platforms for generating and debating ideas on the future, gathering and validating information, and formulating priorities and actions.

The key element in this method is to develop a profile of the panel, i.e. to identify the sorts of expertise and/or stakeholders that should be represented in light of the panel's remit. The composition of expert panels should serve its objectives: a good mix of knowledge, views, institutional representation, political roles, values and disciplines is required to achieve useful and balanced outcomes.
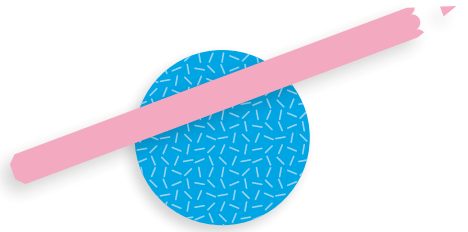
Panel composition is of the utmost importance because, to achieve an outcome which would be perceived to be reliable and legitimate, experts on the panel have to be technically valued and politically recognised. Reliable and legitimate outcomes and panel recommendations for the future are built on factual analyses of the past and present with reasonable confidence of accuracy. This is why research and data analysis, carried out by members of the project team, external consultants, or even panel members, often precedes the panel discussion [13].

Typically experts meet face-to-face at regular intervals over a specified time. However, as a variation there is no need to meet face-to-face and some panels never meet at all: interaction may occur online, and the number of panel members does not need to be limited [14].

An example of an expert panel in practice is described in Box 3.

Box 3.   Expert panel: example of Germany

During the Federal Ministry of Education and Research (BMBF) foresight process a sequence of expert panels is used to identify new future research and technology fields. This helps to specify and refine topics of interest and innovation. The cooperation with experts is based on face-to-face workshops, alternating with online surveys, which lead to a step-by-step reclustering of topics.

The cooperation with experts includes three tools:
- cooperation with a closer group of experts through workshops and interviews;
- a broad online survey of experts to provide a differentiated evaluation of relevance and the need for action (2 659 valid responses);
- using the specific tool for inventor scouting (targeted surveying of young researchers).

The default base is created by nominated topic coordinators who prepare detailed maps of the developments expected over the next 10 to 20 years in 14 of the research fields drawn from the German high-tech strategy.

The goals of the expert panel are to reach consensus on key issues or to identify priorities and to come up with specific suggestions on how these can be implemented. Ideally, a clear plan with accountability of organisations for the implementation of actions is part of the panel's 'political' objectives.

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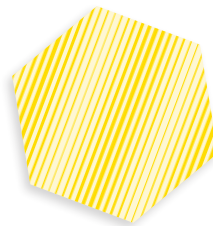
[13] JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: expert panel http://forlearn.jrc.ec.europa.eu/guide/4_methodology/ meth_expert-panel.htm [accessed 12.5.2014].

[14] Ibid.
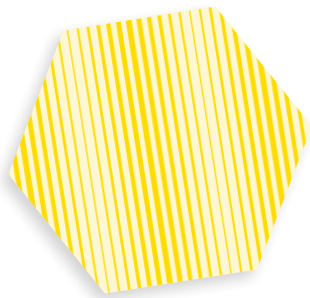
Table 5. Pros and cons of expert panels

Advantages	Disadvantages
• wide perspective on issues • fast feedback • convergent and divergent thinking • good for evidence building • encourages active engagement	• experts can be wrong and miss weak signals • a different group of experts may offer different advice • a dominating personality can take over the panel process

Active engagement of experts is a clear value of this method. Specific forms of the interaction are mostly driven by complementary methods, such as brainstorming, scenarios or SWOT analyses.

2.2.2.2. *Delphi method*

Delphi is another widely used exploratory technique with the aim of structuring group thinking and communication to reflect on complex issues. 'It is particularly used by experts in a series of iterative learning rounds. Delphi first establishes the group's initial view, presents instant feedback on differing opinions, and seeks an agreed position in the final round. Contributors to the group analysis do not have to meet in person and can see the results as they, and their colleagues, add their views in real time. At the beginning, the organiser formulates questions about the future and presents these to the contributors. Contributors respond by adding their rankings and comments. The organisers then modify the anonymous comments received to formulate better questions. The process is run again, in a series of rounds, until a consensus answer is arrived at' (Jackson, 2013, Section 3.7). The Delphi method can be defined as a relatively strongly structured expert group communication process on a topic, where there is incomplete knowledge (Häder and Häder, 1995).

Delphi analysis comprises several activities, where one activity is followed by another to achieve a desired goal. All activities to be performed are shown in Figure 7.

Delphi is an expert survey implemented in two or more rounds, where in the second and later rounds of the survey, the results of the previous round are provided as feedback (Cuhls, n.d.). 'Therefore, the experts answer from the second round on under the influence of their colleagues' opinions, and this is what differentiates Delphi from ordinary opinion surveys. The idea is that the respondents can learn from the views of others, without being unduly influenced by the people who talk loudest at meetings, or who have most prestige, etc. Ideally, significant dissenters from a developing consensus would be required to explain their reasons for their views, and this would serve as useful intelligence for others' ([15]).

The method is particularly useful for assessing the distant future (up to 30 years). The Delphi survey is a qualitative tool and is not meant to be representative ([16]), so the sample typically includes a limited number of respondents. The restricted quantity, however, is compensated for by the quality of respondents whose knowledge and opinions are important, either because of their political status (when they represent important policy institutions or membership organisations) or because of their recognised expertise in the subject.

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[15] JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: Delphi survey http://forlearn.jrc.ec.europa.eu/guide/2_scoping/meth_delphi.htm [accessed 12.5.2014].

[16] Readers interested in the methodology of representative surveys can consult Volumes 5 and 6 on development establishment surveys and tracer studies.
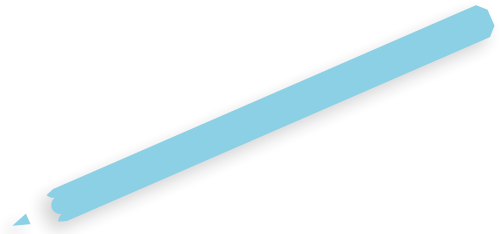
Figure 7. Activities employed in Delphi analysis
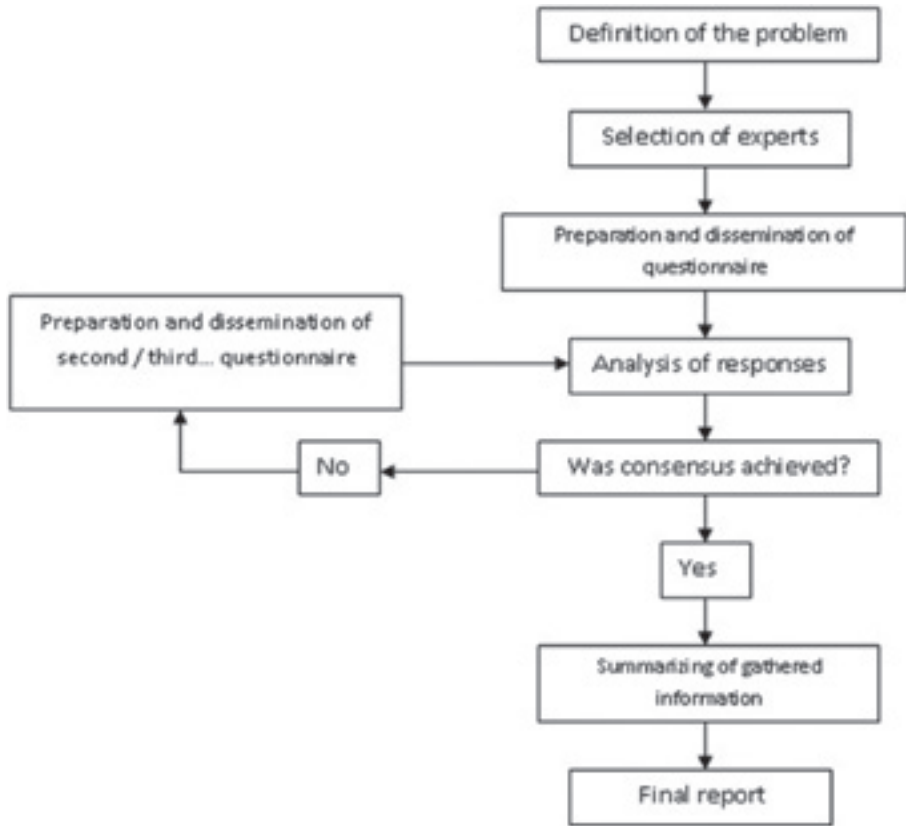
Source: Adapted from Potůček (2006).

Delphi is useful 'where there is no empirical database, where external factors are likely to have a determining effect and where social arguments may dominate economic or technical considerations. As it implies identifying topics that are relevant for the future, it reduces the tacit and complex knowledge to a single statement and makes it possible to judge. On the other hand, in more complex issues, when the themes cannot be reduced that much or when thinking about and discussing alternatives are the major target, Delphi is not the method of choice' [17].

Table 6.   Pros and cons of Delphi analysis

Advantages	Disadvantages
• the possibility of avoiding large group gatherings • virtual participation • handles single or multiple questions • brings together a large number of experts and thus different opinions	• time-consuming process • labour intensive • participant expertise may reduce results • team leaders can bias the results

The Delphi method is usually complemented or supported by brainstorming or scenario development in the preparatory phase to define principal statements. Data from desk-based studies such as a literature and statistics review can also be added [18]. A detailed description of using Delphi in Japan for technology foresight is described in Box 4.

Box 4.   Delphi survey: example of Japan

Japan is known as a pioneering country in science and technology (S&T) foresight. Since the early 1970s such surveys were implemented by means of the extensive Delphi survey and only since the eighth S&T foresight (2003-04) has the Delphi also been accompanied by other methods. In 2009 the ninth S&T foresight was conducted by the National Institute of Science and Technology Policy (NISTEP), an organisation affiliated with the Ministry of Education, Culture, Sports, Science and Technology (MEXT). The whole foresight exercise 'employed a combination of Delphi survey, based on interdisciplinary considerations with future targets in mind, scenario method using several techniques, and region-based discussions (NISTEP, 2010, p. 1). In the Delphi survey, for the first time an attempt was made to outline possible future developments in major areas that were defined irrespective of existing S&T disciplines. The leading question was set as 'what we should do from now on' to reach future goals and resolve the global and national challenges. The main stages of the Delphi survey were the following:

1. four preliminary panels were organised, defined by broad themes: security, safety, international collaboration, and international competitiveness. Experts (from humanities and social sciences, plus natural sciences) discussed future targets that can be attained with the contribution of S&T, and the main global and national challenges. Through the extensive discussions, 24 critical issues were identified;

2. a total of 12 interdisciplinary panels were established to determine relevant future issues irrespective of the existing scientific disciplines. The panels consisted of 135 experts in the humanities, social sciences and natural sciences (from universities, industrial sectors, and research organisations). During their discussions the main topics and areas for the survey emerged. The topics covered elements of, for example, future science, technology, and social systems while the areas represented a group of interrelated topics.

[18] Idem.

Through the discussions, the primary focus was on the sciences and technologies that can contribute to resolving the global and national challenges. The relationship of the topics and areas with the critical issues was also taken into consideration. The names of disciplines or technological fields were intentionally left out of the panel designations. The scope and central theme of the discussion was determined by each panel.

A general framework for subsequent discussions was considered. It was pointed out that the paths through which future science and technology will be assimilated into society are of great importance. Therefore it was necessary to bear in mind the following aspects: systematic research and development involving the interrelated areas of S&T; a point of view that grasps multiple and interrelated areas of S&T as a unified system; research of the methodology for implementation in a society; and an understanding of the social system as an inseparable part of S&T.

Relationship with 12 interdisciplinary panels and four object-specific panels
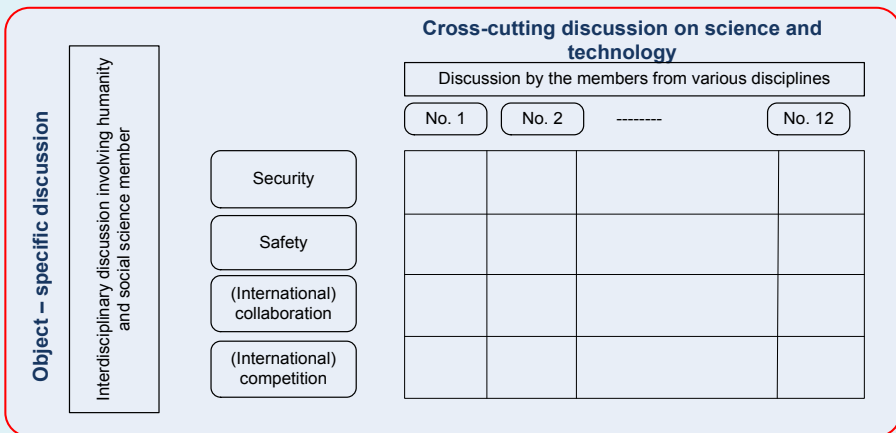
3. two rounds of the extensive questionnaire survey were conducted among experts who offered responses on the future perspective of the topics (832 in total) from the viewpoint of a time span of 30 years until 2040 (focusing on 2025). In the first round, additional questions were designed by each panel about Japan's desired approach to resolving global and national challenges. By the end of the second round, 2 900 responses had been gathered.

4. analyses of the final results from the second round were carried out.

The Delphi survey fed into the multi-methodology ninth S&T foresight that serves as a major recent source of comprehensive intelligence regarding what areas the future policies should focus on. The project outcomes showed that a mission-oriented and interdisciplinary approach is effective for finding out the direction of innovation. An interdisciplinary approach and system-oriented thinking, that includes not only technical systems but also social systems and provision of services, are necessary for grasping the future and embedding technologies in real society, with human resources as one of the key accompanying areas. The results have been used to create a draft of the S&T basic plan of the government and they are also being considered in the process of developing the R&D plans in individual organisations.

Source: NISTEP (2010, pp. 1–4).
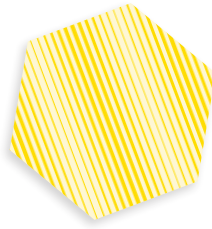
2.2.2.3. *Horizon scanning*

Horizon scanning is both a name given to broad processes of future thinking and also a specific foresight or future tool. As a tool it 'is a technique [designed] to detect early signs of potentially important developments through a systematic examination of potential threats and opportunities' [19]. One of the definitions of horizon scanning characterises this method as a systematic examination of opportunities and likely future developments which are at the margins of current thinking and planning: 'it explores novel and unexpected issues, as well as persistent problems and trends' [20]. Potential changes are usually identified over a long timescale and it is possible to explore the impacts of these changes in terms of what skills will be required in the future.

Horizon scanning is a structured evidence-gathering process based on desk research and expert opinions. It engages experts who are at the cutting edge of their areas of specialisation and makes them look ahead beyond usual timescales and settings. Horizon scanning is a form of collective thinking, but, unlike the Delphi method, diversity in the insights of the group is encouraged. The method works well with a large group of participants (at least 20). The insights discovered can provide the basis for decision-making and for programme development. Horizon scanning has been used in the UK for identifying trends (Box 5).

Box 5.   Horizon scanning: example of the UK

The UK Commission for Employment and Skills carried out the National Strategic Skills Audit for England (UKCES, 2010) with the aim of providing valuable insights into the country's strategic skills needs. Within this project, a 'horizon scanning and scenario' foresight exercise was commissioned to assess the future drivers, challenges and opportunities for UK skills. The St Andrews Management Institute carried out the exercise and produced the report that was one of the key information sources for the National Strategic Skills Audit. Horizon scanning was one of the core methods used, divided into two stages:

1. general scanning.

   The purpose of the horizon scanning was to identify the trends and drivers that may potentially affect the UK's long-term employment and skills landscape and future skills needs. A variety of published information sources was scanned to identify global and national key factors of future development. The factors were drawn basically from the four 'PEST' areas (political, economic, social and technological factors) but also included legal, regulatory and environmental factors. It considered not only issues with a potential impact up to the project's horizon of 2020, but also beyond (over the next 25 years), to stretch the thinking about the future. This extended time horizon could also provide useful material for the eventual further development of the time lines of the scenarios that were drafted in the other steps of the project.

   The general scanning phase identified 101 trends. The raw information extracted during this activity, together with the associated sources, was gathered in a separate 'clippings file'. It has been made available to the client, but not distributed publicly with the final report as it was covered by copyright;

[19] OECD, *Overview of methodologies*: horizon scanning http://www.oecd.org/site/schoolingfortomorrowknowledgebase/futuresthinking/over-viewofmethodologies.htm [accessed 25.6.2014].
[20] Ibid.

2. prioritisation.

In the second step, a project team workshop was held to review the 101 trends. The trends were sorted according to the probability that they would be important to the world in general and impact the UK skills landscape, and grouped into interrelated clusters. A four quadrant chart was created, based on these two dimensions.

The trends with low estimated relative importance for the world and with low impact for the UK skills at the same time (bottom left quadrant) were excluded from further analysis. This resulted in 23 trends and drivers identified as likely to be the most influential factors of future development. These trends were further analysed in the next stages of the project with the help of scenario methodology.

Prioritisation of the drivers

Increasing impact on the UK skills landscape →

Increasing importance on the world	
Infrastructure and networks Rise of China Resource shortages Devolution, EU and trade liberalisation Security concerns	Economic growth in the UK Knowledge economy Cost and availability of capital New technologies Death of distance in working practices Migration Generation Y Reducing carbon emissions Regulation The future of education New jobs and new industries Existing industry
Advances in social science Improving the workplace Declining civic values Outer space Promises	Meeting growing consumer expectations New ways of working Delivery of training online Design and media Ageing workforce in the UK Government interventions to 2020

Source: Duckworth et al. (2010).

As can be seen in Box 5, outputs of horizon scanning are further filtered and refined and often are fed into or linked with other methods such as scenario development or the Delphi method.

Table 7.   Pros and cons of horizon scanning

Advantages	Disadvantages
• identifying future challenges and trends • drawing insights from participants • reviewing a broad spectrum of information, beyond the usual timescales and sources	• outputs must be fed into other methods to gain reasonable results • requires time and research skills • there is always a possibility of missing some weak signals

2.2.2.4.   *Scenarios*

'Scenario planning is one of the most well-known and most cited as a useful technique for thinking about the future' (Jackson, 2013, Section 3.20). 'In foresight projects, the scenario method is a policy analysis tool that helps to describe a possible set of future conditions' [21]. The scenario method is also often used within quantitative forecasting projects to analyse and describe the outcomes of a skills forecast. An example is the pan-European skills forecast by Cedefop (Section 11.1).

'At national, regional and local level scenarios can be used to improve planning capacity, to enrich strategic public policy decisions and to guide major capital investments. Scenarios are a preparation for potential future challenges, not predictions of what will happen. They help us to identify future option spaces and give us confidence to act in a world of uncertainty [...] The method creates plausible views of the future that decision-makers can use to determine their best response and how to react to alternative plays. Scenarios are qualitatively distinct visions, told as stories, of how the future looks. They make explicit the assumptions of how the world works' (Jackson, 2013, Section 3.20).

The main contribution of this method is helping the decision-makers to consider possible options and to choose the preferred vision for future policy decisions. It motivates creative thinking beyond the usual short-term perspective. The following criteria are important for scenario development:

(a) plausibility: a scenario must fall within the limits of what might conceivably happen;

(b) consistency: the logical flow in a scenario must not undermine its credibility;

[21] JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: scenario building http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_scenario.htm [accessed 25.6.2014].
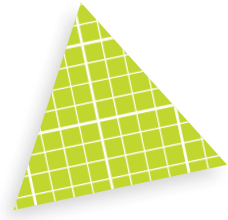
(c) decision-making utility: the purpose is to tell us today what might happen in the future, so we can act upon it ([22]).

There are many different possible ways of developing scenarios. Although they might differ in some features, and use different terminology, they still bear many similarities (Potůček, 2006). Most of them follow a similar process that includes the following stages:

(a) identification of the key issues: this requires a good and fairly narrow focus with the appropriate time-horizon;

(b) identification of key drivers of change that influence the defined issues both at macro/global (social, technological, political, economic, legislative and environmental) and micro level;

(c) prioritisation of the importance of the key issues and the identification of uncertainties surrounding the influence of the drivers of change: this stage leads to developing scenarios with factors with high importance/low uncertainties and high importance/ high uncertainties;

(d) formulation of a limited number of scenarios (plausible, consistent and usable by decision-making) that are narratives of how events might unfold between now and the selected time-horizon and what might happen to each key trend or factor in each scenario.

(e) turning scenarios into strategies and/or determining the opportunities and threats that each scenario brings. It is better not to categorise scenarios as either the most or least likely: keep an open mind to all possibilities. Choosing only one scenario as a goal may blind other developments and possibilities. However, all stakeholders should operate with one common scenario to harmonise their strategies to achieve desirable outcomes ([23]).

Scenarios were used by the Australian Workforce and Productivity Agency to determine what the key drivers of demand and supply are in the Australian labour market to 2025, and which scenarios should be considered – see Box 6.

([22]) JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: scenario building http://forlearn.jrc.ec.europa.eu/guide/4_method-ology/meth_scenario.htm [accessed 12.5.2014].

([23]) Ibid; Potůček, 2006; case studies.
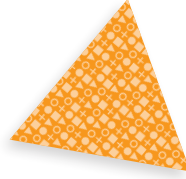
Box 6. Scenarios: example of Australia

In 2012 the Australian Workforce and Productivity Agency developed four possible, plausible scenarios for Australia to 2025 to deal with the uncertainty and limitations of making projections about the future in developing the Future focus, 2013 national workforce development strategy. Scenarios are alternative visions of the possible future and provide a means to make decisions that take account of uncertainty.

The intention is that, by comparing these alternative scenarios, the significance of different uncertainties can be better appreciated. A comparison of the model results based on these scenarios helps to identify how much difference possible alternative future developments are likely to make to the demands for different skills, plus why, and what responses might then be most appropriate.

The four scenarios are:

1. long boom: this scenario is based on a quick recovery by the world economy from the uncertainty of 2011--12. Australia prospers through strong demand for resources, agricultural products and services to Asia, particularly China and India. In a restructuring economy, firms adopt productivity-enhancing strategies to remain competitive;

2. smart recovery: the key characteristic of this scenario is instability in global financial markets, which continues until 2014--15. Economic growth accelerates after governments in the United States and Europe constrain the rate of growth of government debt to a path that markets accept as sustainable. Australia moves out of a low growth economy thanks to the power of technology and the adoption of knowledge work as a critical factor in productivity gains and new job creation;

3. terms of trade shock: in this scenario new global sources of mineral and energy resources lead to oversupply and strong downward pressure on prices. Australia's terms of trade fall, returning to historical levels, and the dollar loses value. However, technology and innovation drive industry restructuring and competitiveness, and other non-mining industries do better;

4. ring of fire: this scenario is a world of continuing uncertainty and volatility characterised by sovereign debt, bankrupt governments and a string of political crises involving many small shocks. Australia becomes more conservative and protectionist, leading to lower growth in productivity and in the economy.

In developing these scenarios a key question was: what are the main drivers of demand and supply for skills in the Australian labour market to 2025? The drivers identified were:

• social, demographic and cultural trends;

• economic and financial trends and globalisation;

• labour force, industrial and workplace trends;

• science, technology and innovation;

• governance and public policy;

• sustainability (focus on water, energy, population).
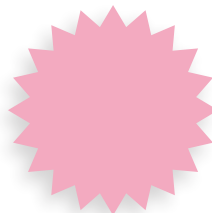
All four scenarios identified common elements which will impact on Australia's future workforce: the ageing population, globalisation, the importance of Asia, the increasing take up of technology and an urgent need for Australia to grow its stock of qualified workers.

To support the work on the scenarios, a range of activities were undertaken:

- a joint forum with the Academy of Social Sciences which included papers from six experts each addressing one of the drivers identified above;
- interviews with 24 experts to inform the development of the scenarios;
- stakeholder workshops to test the emerging scenarios;
- a webinar to provide information about the scenarios and the opportunity for questions and comments;
- a discussion paper followed by a period of consultation;
- provision of inputs to the 2013 national workforce development strategy.

Source: AWPA, *Scenarios for Australia to 2025* http://www.awpa.gov.au/our-work/Workforce%20development/national-workforce-development-strategy/2013-workforce-development-strategy/Pages/Scenario-Development.aspx

Scenarios are usually preceded and supported by SWOT analysis. Also roadmapping (see later) can be used to test the consistency and plausibility of scenarios.

Table 8. Pros and cons of using scenarios

Advantages	Disadvantages
• helps to avoid unpleasant surprises • helps to 'see' the future and so make better decisions today • helps to inspire, engage and enable shared action • helps to identify issues for further horizon scanning	• can be constructed as the 'official future' • people may not be able to suspend their disbelief • may suffer from cultural/cognitive myopia • cannot be validated

2.2.2.5. *Cross-impact analysis*

'Cross-impact analysis is the general name given to a family of techniques designed to evaluate changes in the probability of the occurrence of a given set of events consequent on the actual occurrence of one of them' [24]. Probabilities of the occurrence of events 'can be adjusted in view of judgements concerning potential interactions among the forecasted items' (Gordon, 2003, p. 4). 'The model was introduced as a means of accounting for the interactions between a set of forecasts, when those interactions may not have been taken into consideration when individual forecasts were produced' [25].

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[24] JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: cross-impact analysis http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_cross-impact-analysis.htm [accessed 13.5.2014].

[25] Ibid.

Because future developments may be defined as the result of interactions between trends and events, the first step in this method is to define events that can play a role in the characterisation of future developments of the defined issue [26]. This is crucial to the success of the exercise. The initial set of events is usually compiled from a literature and statistics review and/or opinions of experts; it may also come from actions to collect opinions, such as the Delphi method. Once the event set is determined, the next step is to estimate the initial probability of each event (Gordon, 2003, p. 4). Afterwards, conditional probabilities in a cross-impact matrix 'are estimated in response to the question: "If event A occurs, what is the new probability of event B?" The entire cross-impact matrix is completed by asking this question for each combination of occurring event and impacted event (Gordon, 2003, p. 5). The best way to illustrate this method is by example. Let us assume that there is an event A with initial probability of occurrence 0.5. The other event, B, has an initial probability of occurrence judged to be 0.1. If event

B occurs, the probability of event A would change to 0.65, if event B does not occur, the probability of event A would still be 0.5. The relationship between these events can be also reciprocal; this means that not only does B affect A, but A can affect B. This is the simplest model including only two events; if there are more than two events, all possible relationships and impacts should be determined. All probabilities of the occurrence of a particular event are captured in a cross-impact matrix.

A cross-impact model aims at producing scenarios. It is necessary to employ statistical software, because 'in a model with n events 2n possible scenarios are generated, each differs from all the others in the occurrence of at least one event. For example, if there are 10 events to be considered, there are 1024 possible scenarios to estimate' [27]. The output from the statistical software is usually a list of scenarios ordered from the most probable to the least probable. Generated scenarios need to be interpreted and referred back to the original set of events [28].

Table 9.   Pros and cons of cross-impact analysis

Advantages	Disadvantages
• forces attention into chains of causality; a affects b, b affects c • estimates dependency and interdependency among events • clarifies and increases knowledge of future development	• limitation in the number of included events • difficult to understand consistency and validity of the technique • difficult to explore the future of a complex system with a limited number of hypotheses

Source: JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: cross-impact analysis http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_cross-impact-analysis.htm [accessed 13.5.2014].

[26] Ibid.

[27] IFP, *Cross-impact analysis* http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/analysis/cross-impact-analysis/ [accessed 13.10.2014].

[28] JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: cross-impact analysis http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_cross-impact-analysis.htm [accessed 13.5.2014].

2.2.3.   Normative methods
2.2.3.1.   *Backcasting*

This is one of the most used normative methods and is employed in complex situations where there is a normative objective and fundamentally uncertain future events that influence these objectives. Backcasting defines a desired future and then works backwards to identify the major events and decisions that generated the future, to consider what actions, policies and programmes are needed today that will connect the future to the present. Backcasting reminds participants that the future is not linear, and can have many alternative outcomes depending on decisions made and the impact of external events on an organisation (Jackson, 2013). The backcasting method is shown in Figure 8.

Figure 8.   Scheme of the backcasting method

For each desired future, work backwards and repeatedly ask question „What assumptions and actions must we take to reach a desired future?"

Assumption
Action
Action
Action
Assumption
Assumption   Action
Current state
Action
Action
Assumption   Assumption
Action

Desired future 1
Desired future 2
Desired future 3
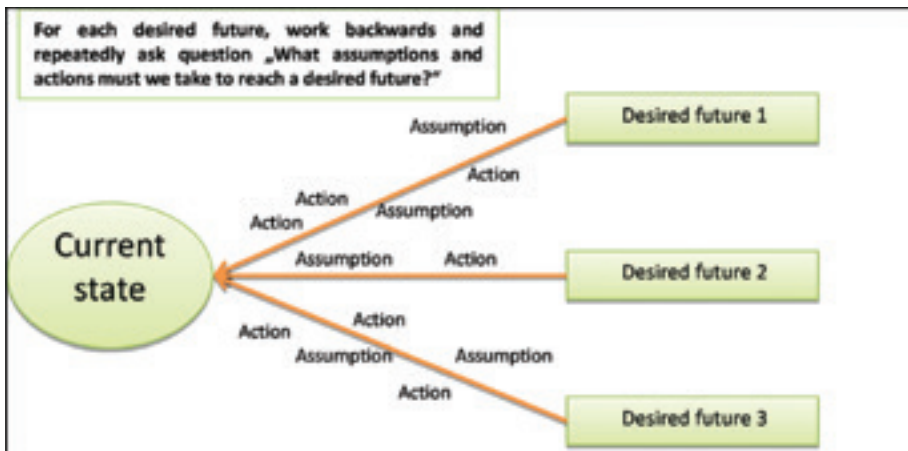
Source: Matthew (2008).
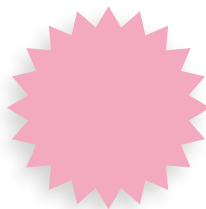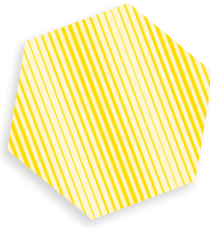
As Figure 8 shows, backcasting comprises several actions needed to achieve a desirable output. According to Wilson et al. (2006) backcasting consists of four steps:

(a) defining the problem context. This 'involves bounding the problem context, setting normative assumptions, identifying stakeholders, considering scale issue and so on';

(b) characterisation of desirable futures. This focuses on construction of visions of desirable futures. These futures reflect the values and wishes of the stakeholders;

(c) backcasting trajectories from future to present. As soon as the desired futures are designed, trajectories are backcast from the future to the present. 'Backcast trajectories are typically described in terms of first-order economic, social, technological and institutional milestones and changes';

(d) identifying interventions to initiate trajectories. 'Backcasting provides a framework for identifying the interventions or actions [policy and strategy measures] required to implement the trajectories which would lead to the desirable future' (Wilson et al., 2006, p. 144).

It is important to involve stakeholders at an early stage in the process and develop a future long-term vision of the desired scenario. Once the collective desirable vision is developed, alternative paths to achieve it are proposed and scrutinised in terms of potential advantages, disadvantages, bottlenecks and problems. Stakeholders then select one pathway, formulate an action plan defining their roles, and commit to them. Box 7 shows how backcasting has been used in practice in the UK.

Box 7. Backcasting: example of the UK

In 2006 the Tyndall Centre for Climate Change Research in the UK used a backcasting approach within the project Decarbonising modern societies: integrated scenarios process and workshops. This project focused on creating strategies 'to reduce UK CO2 emissions by 60% by 2050 relative to 1990, a goal adopted by the UK Government. The study took a backcasting approach which has been applied in two stages' (p. 1). Before applying backcasting, brainstorming was used with the aim of generating 'a list of issues which […] would drive the future of the UK's energy system to 2050' (p. 13).

'Then a set of credible and consistent end points describing the energy system was devised, outlining alternative visions of a substantially decarbonised society in 2050. […] These end points were used as the basis for a backcasting workshop where experts and stakeholders articulated pathways for the transition to the defined futures' (p. 1).

'Stakeholders were recruited from the policy community and from those with expertise in policy formulation and implementation. The backcasting was structured into a series of steps so that participants initially thought about the critical factors required for a particular end point to be achieved and subsequently elaborated these to define how they might be achieved. The project team took the output from this workshop and combined the end points and pathways to form the Tyndall integrated scenarios' (p. 4).

There were 'five detailed scenarios which described the transition from the present day to the contrasting end points. The scenarios outline demand and supply side characteristics and policy steps through which change has been brought about in the most important sectors' (p. 4).

Developed scenarios described ways to reach future end points, and also dealt with the impact of particular scenarios and related changes on employment and future skill requirements. It is clear that each scenario contained a different impact on the labour market, and thus on the skills and competencies required in the future.

Source: Anderson et al. (2006).

Table 10. Pros and cons of backcasting

Advantages	Disadvantages
• lightweight and creative	• assumes the desirable future will occur
• avoids extrapolating present conditions	• may need constant updating
• the proactive character of backcasting – shaping the future by designing the action today	• can be resource intensive
• accessible and engaging	

The main outputs of backcasting are future visions and ways to achieve them, discussed and agreed among key stakeholders.

2.2.3.2. *Morphological analysis*

'Morphological analysis [... is] a normative method, which starts with future needs or objectives, and then seeks to identify the circumstances, actions, technologies, etc., required to meet them' [29].

The purpose of morphological analysis is to organise information to solve a problem or stimulate new ideas. It has widespread use for new product development but it is particularly useful in foresights for building scenarios [30]. 'Morphological analysis is a method, which breaks down a system, product or process into its essential subconcepts, each concept representing a dimension in a multidimensional matrix. In this context every

system, product or process is considered as a compound of attributes. New ideas are found by searching the matrix for new combinations of attributes that do not yet exist' [31].

Morphological analysis can be based on five steps:

(a) defining and formulating a problem;

(b) defining and analysing the parameters that might be of importance for the solution of the given problem;

(c) constructing a multidimensional matrix with possible solutions;

(d) evaluating the outcome based on feasibility and achievement of desired objectives;

(e) analysing the best solutions being selected and applied, provided the necessary means are available [32].

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[29] JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: morphological analysis and relevance trees http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_morpho-analysis.htm [accessed 13.5.2014].

[30] Ibid.

[31] DIEGM, University of Udine, *Morphological analysis* http://www.diegm.uniud.it/create/Handbook/techniques/List/MorphoAnal.php

[32] JRC-IPTS, *For-Learn online foresight guide*: methodology: main methods: morphological analysis and relevance trees http://forlearn.jrc.ec.europa.eu/guide/4_methodology/meth_morpho-analysis.htm [accessed 13.5.2014].
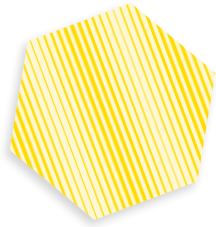
Table 11. Pros and cons of morphological analysis

Advantages	Disadvantages
• can discover new relationships, which may not be so evident • encourages the identification and investigation of boundary conditions • systematic analysis of future structure of the system	• may be too structured and that could inhibit creative thinking • may yield too many possibilities • human error: method requires critical judgement

2.2.3.3. *Roadmapping*

The term 'roadmapping' (usually understood in terms of technology roadmapping) refers to various kinds of foresight studies including visions and detailed projections of possible future developments. It is a normative method that aims to look at the future for a chosen field and to seek the most important drivers of change in that field [33]. It provides inputs for the formulation of policies and strategies (UNIDO, 2009).

There are many approaches to roadmapping, although generally the effort is a graphical depiction that provides a strategic view of the given subject (Phaal and Probert, 2009). This depiction can be used by presenting the way forward and informing decisions about possible future options. An example of visual representation, comprising a multilayered, time-based chart, bringing together various perspectives, is shown in Figure 9.

Figure 9. Graphical representation of technological roadmapping
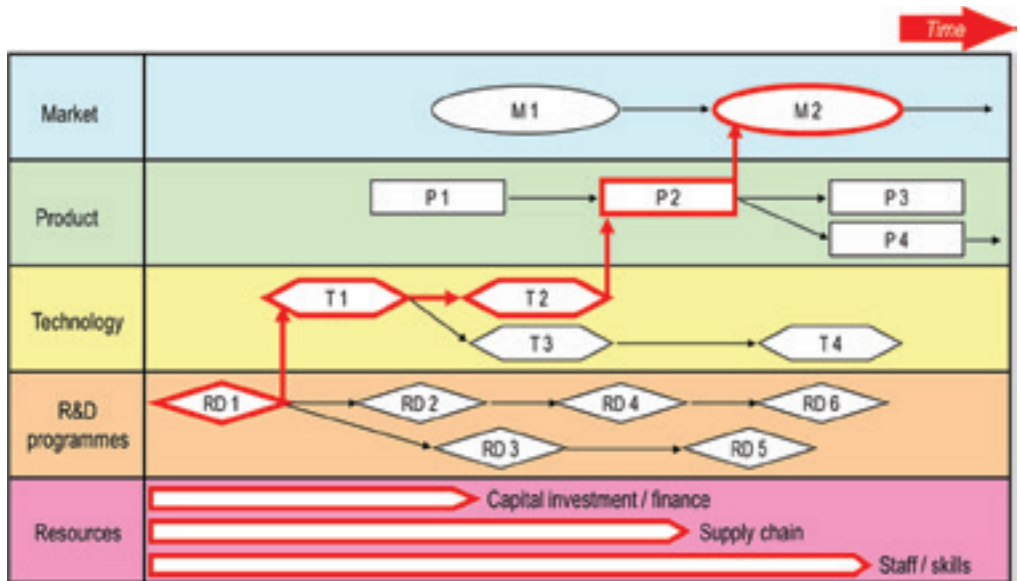
Source: EIRMA (1997).

[33] Ibid.
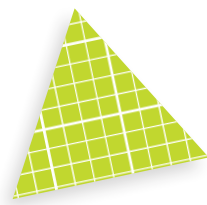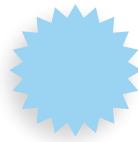
Roadmaps can be considered as dynamic business or system frameworks, which enable the evolution of systems to be explored and mapped, supporting innovation and strategy development and deployment at all levels (UNIDO, 2009). The different 'ways' in roadmaps are designed by experts.

Even though roadmapping is usually used in technology foresight, it can also be applied when it comes to other research areas or issues, linked directly to questions that are applied in any strategic context:

- Where do we want to go? Where are we now? How can we get there?

- Why do we need to act? What should we do? How should we do it? By when?

The approach is quite flexible and can be adopted to suit a wide range of goals and context (UNIDO, 2009).

Table 12.   Pros and cons of roadmapping

Advantages	Disadvantages
• graphical representation is an effective way to demonstrate relationships • a means to develop consensus about a set of needs and steps required to satisfy those needs • can help to identify key elements within a complex system	• due to the broad complexity of the issue roadmapping can be challenging • no single format is suitable for all situations: the approach has to be customised • it is a well-structured method which does not allow for large participation

2.3.   Conclusion: how to choose a method, or methods

'The variety of foresight experiences demonstrates that no one method or structure is best: the choice must reflect both fitness for purpose and the national culture in which it is situated'. According to Georghiou et al. (2008), any foresight exercise 'is neither a single approach to a single problem nor a panacea for all national problems' (Georghiou et al., 2008).

Key questions to meet the objective(s) of the foresight are 'How to choose proper foresight methods?' and 'How to combine foresight methods?'. Choosing an appropriate method or, better, a combination of methods is a challenge. According to Jackson (2005) the selection of foresight methods should match the project's objectives: the desired project outcomes and the information needs of stakeholders. A combination of methods is usually used in foresight exercises, quite naturally given that some methods can relate to each other and are used in sequence. According to Keenan combining foresight methods should be based on these criteria:

(a) 'available resources (time, money, expertise, etc.);

(b) nature of desired participation;

(c) suitability for combination with other methods;

(d) desired outputs of a foresight exercise;

(e) quantitative/qualitative data requirements of methods;

(f) methodological competency [34] (Keenan, 2006, slide 4).

The cultural, economic, political, social and institutional contexts play a crucial role and have to be taken into consideration as well. Table 13 summarises all foresight methods and describes some of their specifics.

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[34] The terms competency(ies) and competence(s), although slightly different in meaning, are used interchangeably throughout this publication.
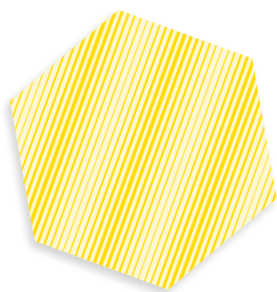
Table 13.   Foresight methods

Method	Type	Country examples*	Suitability for skill needs anticipation**	Usually used together with	Important features of method
Backcasting	Normative	–	+++	Literature and statistics review	Provides a clear path forward
Brainstorming	Supplementary	Japan, the US	++++	Expert panel, Delphi method	Can reveal unexpected developments
Cross-impact analysis	Exploratory	–	++	Literature and statistics review, Delphi method	Evaluates the probabilities of the occurrence of a set of events
Delphi method	Exploratory	Brazil, Germany, Finland, Japan, Korea	+++++	Literature and statistics review, brainstorming, scenarios	Good for spotting the unexpected, and for engagement of stakeholders
Expert panel	Exploratory	Brazil, Canada, Germany, Finland, Japan, Korea	+++++	Scenarios, brainstorming, SWOT analysis	Eliciting expert knowledge, helping to identify priorities
Focus group	Supplementary	–	++++	Scenarios	Improving or generating ideas
Horizon scanning	Exploratory	the UK	+++	Scenarios	Identifying future challenges and trends
Literature and statistics review	Supplementary	Korea	++++	Scenarios, backcasting, Delphi method	Evidence-based
Morphological analysis	Normative	–	++	Scenarios	Breaks down a system and identifies important factors
Scenarios	Exploratory	Brazil, Germany, Japan, Korea, the UK	+++++	Literature and statistics review, SWOT analysis, science and technology roadmapping	Good for spotting the unexpected, and for engagement of stakeholders
S&T roadmapping	Normative	Russia	+++	Scenarios, brainstorming, expert panel	Provides a clear path forward
SWOT analysis	Supplementary	–	++++	Scenarios, expert panel, Delphi method	Lists factors with impact on issue

NB: * Reference from case studies; ** the more +, the more suitable the method is for anticipation (maximum five+).

Source: Authors.
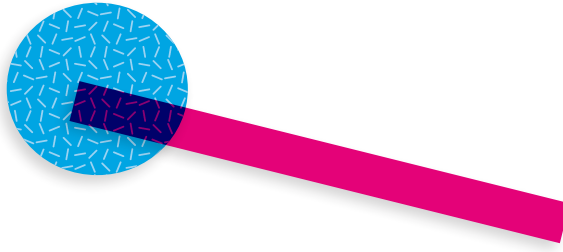
A survey by the European foresight monitoring network mapped 866 different foresight exercises (European Commission, 2009) and examined how various techniques were combined in practice. The outcome of this survey is summed up in the methods combination matrix (MCM), shown in Table 14.

Table 14.   Methods combination matrix (MCM)

Ranking by frequency of use		1	2	3	4	5	6	7	8	9	10
Methods Combination Matrix (MCM)		Literature and statistics review	Expert panels	Scenarios	Brainstorming	Delphi method	SWOT analysis	Roadmapping	Backcasting	Cross-impact analysis	Morphological analysis
1	Literature and statistics review	477	H	H	M						
2	Expert panels	VH	440	M	M	M					
3	Scenarios	H	H	372	M						
4	Brainstorming	VH	VH	H	169	M	M				
5	Delphi method	VH	VH	M	H	137					
6	SWOT analysis	VH	H	H	H	M	101			M	
7	Roadmapping	VH	VH	M				72			
8	Backcasting	H	H	H	M				47		
9	Cross-impact analysis	VH	VH	VH	VH	M	VH			36	M
10	Morphological analysis	VH	VH	VH	VH	M	M		M	H	21

NB: (VH) very high, (H) high, (M) moderate, (blank) low.
            Focus groups and horizon scanning were not included in the MCM.

Source: Adapted from Popper (2011).
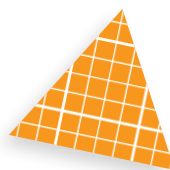
The diagonal shows the total number of times the method was used in the sample of 866 cases. The methods most used in foresight exercises are literature and statistics reviews, expert panels and scenarios. 'The outcome of this operation shows in each cell the proportion in which two methods are combined with respect to the number of times the method on the row was used. Nevertheless, to present the results in a more "digestible" way, the following categories have replaced the percentages: "blank" for low combinations (i.e. figures below 19%); "M" for moderate combinations (i.e. 20-39%); "H" for high combinations (i.e. 40–59%); and "VH" for very high combinations (i.e. figures above 60%)' (Popper, 2011, p. 24). Although, only some of the quoted cases were for anticipation of skill needs, the matrix shows which methods are combined with others more generally.
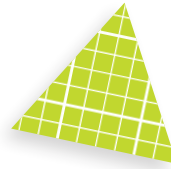
Chapter 3.
Key steps in implementing foresight programmes

3.1. Define foresight area to be considered

Defining the focus of the foresight exercise is essential before starting. It usually tackles one core issue but different types of focus may coexist (e.g. future skills shortage in a selected sector).

Box 8. Finding research fields and topics: BMBF foresight in Germany

The BMBF foresight is a strategic instrument of the Federal Ministry of Education and Research (BMBF) that provides technology foresight with a time horizon of approximately 10 to 15 years. It is characterised by combining two approaches in a cyclic process model: a cycle strongly influenced by the technology push approach is followed by a cycle that is mainly demand pull orientated. One cycle lasts about two years and leads to a long-range look into the future needed for early agenda-setting and prioritisation in German research and innovation policy, including prospects for change in the education system. Research fields defined by the high-tech strategy and by other foresight activities of the Ministry are being examined and refined within this cyclic process.

The process in each cycle is carried out in several phases: search and analysis, transfer, and preparation of the next cycle. Cycle 1 started in 2007 by mapping 17 proposed fields. They were discussed by experts at workshops, followed by initial reclustering, an online survey and second reclustering. By mid-2009, 'future topics' were identified (neurosciences, optical technologies, water infrastructures) along with seven 'new future fields' (including production consumption 2.0, sustainable energy solutions). In cycle 2 (since 2013) broad trends in demand pull will be determined and evaluated. Results from research in social sciences, humanities, political sciences and economics will be included along with the results from interviews with lead users and people who exhibit a particular openness to sociocultural changes.

On the basis of this cycle, hidden trend developments may be added into the analysis which also extends to education policy, skills and labour market changes. The results of cycle 1 and cycle 2 will be updated, combined and linked to scenarios to point out future areas within research and science which have the greatest solution potential to be considered in Ministry policy.

Source: Cuhls et al. (2009). See also the case study in the annex.
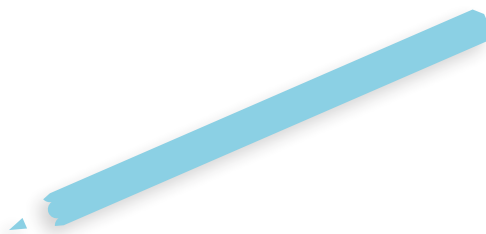
Ideally the focus should be discussed and defined together with main sponsors, implementers and participating partners. This is a useful time investment in managing expectations and to avoid potential disagreements on desired outcomes. Formulating a guiding question for the foresight exercise may be useful ([35]).

3.2. Clarify the purpose of the foresight exercise

The first step when thinking about a foresight programme is to see if it can provide the kind of information sought and fulfil expectations: what role can a foresight exercise play in meeting key social challenges for stakeholders? The main motive for foresight should be enriching the understanding of likely future circumstances and potential strategies to bring about a desired future. Foresight generates shared visions. Some national exercises have succeeded in achieving widespread consensus on these visions but consensus is difficult to achieve in areas where there are profound underlying disagreements. Further, employing foresight activities may not always be appropriate. If the purpose is to bring quantifiable knowledge of future skill needs, foresight is perhaps not suitable ([36]); projections or extrapolating activities can produce desired outputs provided robust data are available.

Although the foresight process has the value of making stakeholders interact and discuss, it is not an end in itself: implementing a foresight exercise can only be justified by its desired impact. Whether the latter can or cannot be achieved depends not on the quality of foresight but on many conditions beyond the scope of the foresight team. It is necessary, therefore, before committing time and resources, to undertake a feasibility check on whether these conditions will allow the desired impact to be achieved beyond the foresight project life.

3.3. Clarify the key programme design elements

Once the focus of the foresight exercise is clear and the decision to proceed is taken, a number of important issues need to be planned: objectives, expected outcomes, foresight time horizon, partners, stakeholders, participants, scope, methods and formats to apply, and time and resources to allocate for the exercise.

Ideally, objectives should be clearly formulated but, unlike the foresight focus, do not have to be too specific, at least at the initial stage of the process. Gaining as broad support as possible early on is important but, again, managing expectations is necessary to avoid promising too much to too many players ([37]). The general objectives of foresight comprise four main activities:

(a) stimulating common discussion about the future and support for long-term thinking;

(b) collecting and combining widespread information by gathering important protagonists and improving shared knowledge in consequence;

(c) supporting creation of networks and stimulating common action;

(d) providing information and improving the quality of present-day decisions.

There is no single objective in foresight activities. The main output of foresight is to influence policies to maintain quality of life and social and political cohesion. This can be achieved only through accomplishing several partial objectives. Foresight should tend to set priorities and create 'visions', gather a range of opinions from stakeholders, enhance networking and provide information.

([35]) JRC-IPTS, *For-Learn online foresight guide*: major decisions: defining the focus http://forlearn.jrc.ec.europa.eu/guide/3_scoping/dec_focus.htm [accessed 14.5.2014].

([36]) Part B deals with quantitative forecasts.

([37]) JRC-IPTS, *For-Learn online foresight guide*: scoping an exercise http://forlearn.jrc.ec.europa.eu/guide/3_scoping/index.htm [accessed 14.5.2014].
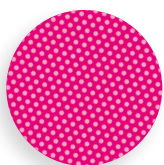
Care in determining scope helps achieve the objectives of the foresight exercise. Defining the scope means choosing the appropriate level of intervention and relevant topics, and combining them with the agreed focus into a coherent design for the exercise. The case of Russia (see annex) demonstrates that the scope of the project Skills 2030 foresight was defined as the sectors where technology has been the primary driver of change in skills demand. The topics focus on working tasks and related skills.

Key stakeholders need to be identified and involved. Stakeholders involved in foresight are groups of people that affect, are affected by, or have an interest in particular foresight activity. One apparent, although not always mandatory, stakeholder is the sponsor of the foresight. Other stakeholders may include direct and indirect users and beneficiaries of the foresight results, who should all be considered in the design of the foresight exercise to maximise its benefits.

Mapping out the stakeholders includes considering the degree of their interest in particular issues. The different foci of a foresight exercise help to define the format of the desired outcome in relation to possible users. Stakeholder groups can help to define the outcomes being aimed for. Typical stakeholders in skills foresight are government and its bodies (ministries, agencies) at national/regional/local level, employers and their bodies, trade unions, research centres and specialised institutions, public employment services, and education and training providers. Skills foresights include elements of social dialogue between government and the private sector in its core activities. More information on stakeholders to be involved in skills anticipation and matching activities are provided in Volume 1. For work on the sectoral level, the involvement of stakeholders and the role of social dialogue are discussed in-depth in Volume 3.

Box 9. Involving stakeholders

The composition of participants will depend upon the orientation of foresight activities; several practical approaches can be used to identify appropriate individuals. One of the main aims of foresight activities is to ensure the maximum involvement of leading players because this will help determine the final outcome, whether foresight is focused on formal activities, or on the activation of learning processes and development of specific skills. The correspondence between foresight objectives and stakeholder needs depends greatly on the number of key players involved and their effective participation, as well as their ability to intensify relationships of exchange within the issue and with regard to external contexts.

The success of the foresight programme – and thus its ability to attract sponsors, engage stakeholders, and put the results to effective use – will depend on its ability to mobilise sources of energy. As the effectiveness of each foresight activity is strongly influenced by the number of key players involved and their degree of participation, in order to avoid casual or misguided choices, the identification of these players must follow in-depth analysis of the local system and refinement of the general objectives of foresight activity.

Participants must be identified according to the focus of the foresight activity, which will, in turn, be dependent on the objectives of the initiative and country circumstances. It is necessary to consider the main components of the system: objectives focusing on improvement of the training system will involve leading public decision-makers at both local and national level, as well as the public and private training supply systems, and players representing the demand for vocational skills.

Three ways to recruit members and participants

Through personal contacts
using names known to those
already involved in the project.
You should ensure that key
stakeholders are represented

Through stakeholders involvement
you ask the identified stakeholders to
give you names

Through a formal process
1. Define the profile of desired membership
(stakeholder type, expertise)
2. List together with other already involved people all
the names you can imagine
3. Contact every person and ask two questions :
  • Would you be interested ?
  • Do you have two other names ? This allows
  new unexpected names to come up
4. Match names & profile membership and finalise list
5. Confirm to every person

Arguments to encourage participation in the exercise should emphasise the potential benefits of establishing foresight activities. They should primarily focus on the types of benefit to be gained from the setting up of a foresight activity. Such benefits can be divided into three types:

- 'entry point' benefits connected to the preparation of specific programmes for submission to national and European financing. In this case, both local institutions and the various members of the training and social systems will have specific interests in defining projects and programmes to attract resources into the system;

- benefits connected to long-term objectives, aimed at improving performance of the system. These objectives depend on the structural features and may address aspects such as general economic development, improvement of sector competitiveness, and greater dissemination of technologies in production and social systems. Obviously, the most suitable arguments for involving players will depend on the objectives identified and the relative benefits. For example, in the case of a foresight activity aimed at achieving better skills matching by adjusting education and training provision, the arguments to be used with public authorities should revolve around improvements in terms of public budgets (less unemployment and related social problems). Citizens, on the other hand, should be made aware that they will benefit from such improvements; arguments might focus on the benefits from making better informed choices about a future career. Employers might benefit from the better availability of a ready workforce;

- benefits connected to the creation or strengthening of harmony between players. In this case, the arguments, especially those aimed at political decision-makers and employers and entrepreneurial associations and trade unions, should highlight the potential impacts of foresight activity. These could include improved interrelations, cohesion and the generation of a shared vision between players. This type of benefit also has a direct effect on the advantages to be gained from the foresight activity by individual participants. For example, individual enterprises can improve their knowledge of the technological and economic scenarios in which they compete, while individual citizens can increase their preparedness for new technologies and jobs, and so improve their quality of life.

Project management practice can help to prioritise stakeholders: there may be a long list of people and organisations that are affected by the foresight exercise. The power/interest grid shown below classifies key players by their power over and interest in the programme.

The power/interest grid
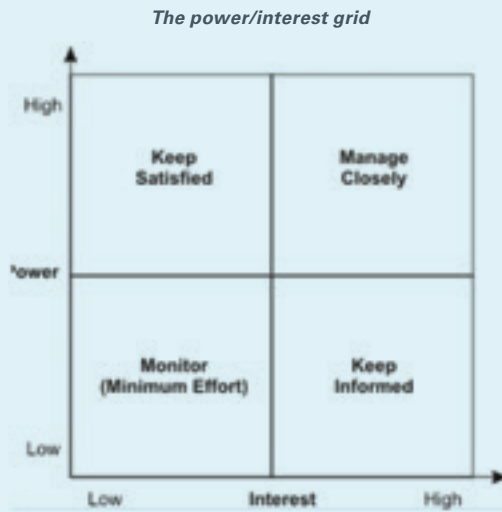
Source: Kot, *Requirements technique: stakeholder power/interest analysis:* http://requirementstechniques. wordpress.com/stakeholder-analysis/stakeholder-powerinterest-analysis/ [accessed 25.6.2014].

The positions on the grid suggest action to be taken:
• high power, interested players: these must be fully engaged and the greatest efforts have to be made to satisfy them (sponsors, government representatives);
• high power, less interested players: enough effort has to be made to keep them satisfied;
• low power, interested players: they should be kept adequately informed about any major issues that may arise;
• low power, less interested players: they should be monitored but not burdened with excessive communication.

Source: JRC-IPTS et al. (2001).

The next step involves translating the defined objectives into specific results expected to be achieved through the foresight exercise. Such results could be tangible, such as reports, books, websites, institutionalised networks, strategic documents, or intangible, related to the process itself, such as informal networking, consensus on issues discussed, collaboration among stakeholders and social dialogue. Expected outcomes from the foresight exercise have to be clearly defined and related to specific groups of stakeholders: part of this process is describing the outcomes in language relevant to the audience (38).

Defining a time horizon is the next step: this has to be done taking into account the subject of the foresight and its dynamics. Many methods only work for certain time horizons and so the decision on how long into the future the foresight should look has to be taken before selecting methods (39).

3.4. Clarify key questions and the way to find answers

Selecting an appropriate methodology should be done early in the foresight design process. The chosen methodology should be problem-solving driven and result-oriented. It should also take into account feasibility of the implementation and resources needs/constraints. The resources include availability of time including that of participating stakeholders, money, expertise including that of a facilitator, venue, equipment and access to data. These considerations should help in the selection of a set of methods to be applied at different stages of the process in the appropriate sequence, taking into account their suitability for combination with other methods, the desired outputs of the foresight exercise, quantitative/qualitative data requirements of the methods and methodological competency (Keenan, 2006). The selected sequence of methods will normally evolve and might be altered or refined throughout the process. The methods have to be discussed with the sponsor, the team and key stakeholders (40).

3.5. Manage the foresight exercise

The foresight implementation plan has to include a number of organisational issues, such as forming the implementation team and assigning roles and responsibilities to its members, setting up a steering committee, outlining a communication strategy, estimating and securing financial and non-financial resources, contracting external collaborators, and forming expert working groups if necessary.

Once these design issues are resolved the programme can be launched. Managing the foresight exercise poses a number of challenges. Due to the highly participatory and interactive nature of the approach, continuous adjustment of the process without jeopardising the overall outcome is a challenge. Other issues are managing time and people, including relationships with the sponsor and the stakeholders, and the engagement of participants (41).

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(38) JRC-IPTS, *For-Learn online foresight guide*: major decisions: defining the outcomes http://forlearn.jrc.ec.europa.eu/guide/3_scoping/dec_outcomes.htm [accessed 14.5.2014].

(39) JRC-IPTS, *For-Learn online foresight guide*: major decisions: defining the time horizon http://forlearn.jrc.ec.europa.eu/guide/3_scoping/dec_time-horizon.htm [accessed 14.5.2014].

(40) JRC-IPTS, *For-Learn online foresight guide*: methodology: methodological framework http://forlearn.jrc.ec.europa.eu/guide/4_methodology/framework.htm [accessed 14.5.2014].

(41) JRC-IPTS, *For-Learn online foresight guide*: running an exercise http://forlearn.jrc.ec.europa.eu/guide/3_running/index.htm [accessed 14.5.2014].

Box 10.   Foresight programme team skills

Carrying out a foresight exercise requires appropriate skills among members of the foresight implementation team. Their competency profiles and prior foresight experience are critical. Therefore, selection of the project team and division of roles and responsibilities need careful consideration.

Many actors are involved in a foresight exercise: universities, businesses, chambers of commerce, media, industry associations, sponsors, experts, NGOs. Foresight exercises can potentially involve dozens of participants from a wide variety of organisations and backgrounds. Identifying participants depends on the orientation of the foresight exercise. Objectives focusing on anticipation of skill needs will involve political representatives, public decision-makers, employers and their associations, research centres and specialised institutions, public employment services, trade unions and education and training providers.

Depending on the objectives of the foresight exercise and on the methods employed – a number of competencies are required during the process. It may be that the right people with the right competencies are not available within the foresight team (for example facilitators for workshops, rapporteurs for panel discussions, designers for online surveys, foresight experts). There are strategies for solving this problem: by training the project team, by bringing external competencies into the project for specific tasks or by outsourcing parts of the project (e.g. using professional consultancy for facilitating discussions). It is recommended to think carefully from the start about what competencies will be needed during the foresight process and what strategies are needed to recruit the right people.

Special attention should be given to foresight experts and their skills and competencies. Especially experts with knowledge of specific foresight methods are rarely available from local sources; often they are not available even in the country. In practice, accessible local experts use methods they are familiar with or which are fashionable, but not in correspondence with the objectives of the foresight exercise. This can cause serious problems in achieving the foresight objectives. In such cases it is necessary to recruit experts from abroad and use their expertise and knowledge.

Sources: Case studies (see annex); JRC-IPTS, *For-Learn online foresight guide*: methodology: methodological framework http://forlearn.jrc.ec.europa.eu/guide/4_methodology/framework.htm; scoping an exercise: setting up: team member profiles http://forlearn.jrc.ec.europa.eu/guide/3_scoping/set_team_profiles.htm; [links accessed 14.5.2014].

Implementation of a foresight programme consists of two phases. The first phase incudes collection, collation and summary of available information. Collection of 'information on future themes, trends, ideas, early signs, etc., is gained from a wide range of sources such as experts, universities, business networks, personal networks, the literature, government, other foresight reports, research and surveys by means of different methods such as Delphi, surveys, systematic reading, or brainstorming sessions'. Collation and summarisation give the information a structure and form and its volume is reduced. 'Again, there are general methodologies and processes available, such as scenario building, list writing and prioritising, graphical comparisons, [matrix production], and cross impact analysis' (Horton, 1999, p. 2).

Actual foresight comprises the translation and interpretation of this information to produce an understanding of its implications for the future from a specific point of view (such as for education and training). It involves activities, tools and skills, as well as people to do the translation and interpretation work for education, training and skill needs and to assess what can be done about it today. This is the value-added phase, generating an understanding of what can (or cannot) be done for the future.

3.6.   Ensuring the use of results

The life of foresight does not stop at the end of the implementation of the foresight activity itself; it includes tasks related to the use and dissemination of the results, their evaluation, and reflection on the lessons for future foresights [42].

Often, insufficient attention is given to follow-up, and recommendations produced never get to the implementation stage. The key to success is to include implementation into the foresight implementation plan and treat the task as part of the exercise. This does not mean that the foresight implementation team will have to implement the strategy that results from the foresight themselves. They may initiate broader collaboration, engage other institutions and delegate to other authorities, but the plan for the foresight afterlife has to be in place.

The responsibility of foresight programme implementers does not usually go beyond the delivery of programme outcomes to stakeholders or end users. Stakeholder expectations should be continuously managed during the programme so that their needs are met adequately. Benefitting from programme results is a matter of stakeholder engagement and ownership over the programme. Foresight programmes that have highly engaged stakeholders with strong ownership will more likely result in follow-up actions that will implement foresight outcomes. But these activities are usually 'out-of-the-scope' of the foresight exercise.

Evaluation has to be an integral part of foresight exercises. Evaluations ideally look not only at products, results and outcomes but also processes. Evaluating outcomes is essential for accountability to client and users, whereas evaluating processes is important for future foresights [43]. Understanding what worked and what has to be changed will help to draw lessons and share good practices, with a view to systematising foresight activities.

[42] JRC-IPTS, *For-Learn online foresight guide*: follow-up of the exercise http://forlearn.jrc.ec.europa.eu/guide/6_follow-up/index.htm [accessed 14.5.2014].

[43] Idem.

Chapter 4.
Adapting foresighting to local needs

4.1. Key context factors

This guide argues that rather than presenting a 'one size fits all' approach universally or within a group of countries, it is more convenient to consider opportunities and barriers that arise from country specifics. Reviewing the cases, a number of general circumstances that have influence on foresight activities have been identified. The context factors provide a framework for the application of any foresight approach and need to be considered at national level. Understanding them helps in making better strategic decisions about foresight activities.

The list of following themes is not exhaustive but indicative of the areas where initial assessment is useful when thinking of developing or adopting a foresight approach. Though considered separately, these areas are closely interrelated.

4.1.1. Country size

Country size, represented by the number of inhabitants or members of the workforce, influences the scope of foresight activities. For example, the population of Brazil represents two-fifths of the whole EU population, making foresight activities at national level incomparable with small European states which are the size of Brazilian states. The size is reflected in the complexity of the management of foresight activities (such as the size of expert panels). The country area also matters. As seen in the Brazilian case (see annex), spatial skills mismatch is an issue that calls for attention. Small countries may also find some national foresight approaches difficult to apply because they may be too closely linked to their bigger neighbours (so that skills gained are used elsewhere due to cross-border commuting).

4.1.2. Economic and social context

Developing or transition countries have several common features related to their level of social and economic development, so the main skills issues may vary from developed countries. As demonstrated in the Brazilian case, illiteracy and basic education quality can undermine efforts to develop and better match skills with the labour market.

Economic growth is important but does not necessarily make foresights easier to implement, influencing as it does context factors (such as political and institutional stability). An unfavourable economic situation may disconnect new technologies from the main social problems of a country and polarise the workforce. The Brazilian case shows (see annex) that social progress and increased social inclusion linked with good economic conditions (reduction of poverty, informality, inequality) directly affects the number of workers included in government-monitored activities and makes foresight exercises more valuable.

There is a link between the level of development and foresight experience in countries. From the cases considered here, Japan, Germany and South Korea have gathered most foresight practice and can provide more examples on the use of specific methods. The relevance of the foresight methodology to other

countries, including transition and developing countries, is high but the feasibility of applying specific methods must always be carefully considered (taking into account for instance the existing statistical infrastructure or availability of expertise and foresight competencies).

4.1.3. Political stability and culture

Developing foresight culture or carrying out a meaningful foresight exercise requires an environment in which a certain degree of continuity of public processes and policies is allowed. Instability of public institutions due to the changing focus of political leaders and governments is a risk element for developing foresight activities and for their success.

Success of foresight activities requires a degree of forward-looking thinking by political leadership. Many countries where reactive short-term thinking penetrates all areas of public administration may find it difficult to start developing a foresight system that by its nature serves mid- or long-term goals.

The perception of the necessity of change is an important policy aspect. In countries where substantial political or cultural changes are common, foresight is more likely to become part of the policy response since it helps to guide today's decisions for the desired future.

4.1.4. Openness and vulnerability to external changes

Generally, smaller countries tend to be more open and vulnerable to external changes. Economic structures and labour market adjustment are more prone to global trends. However, the degree of openness can be influenced by political decisions, as in the 1990s when Brazil embarked on an outward-looking development strategy and opened up its economy. Other countries may be satisfied with more inward-looking strategies, sticking to the low-skill equilibrium where little pressure is put on increasing skills. In such cases foresight interventions may be pointless.

4.1.5. Cultural context

Different cultures (western, eastern, regional, institutional) and their values can affect the way foresight is developed and implemented (such as the transferability of some practices). Differences in the operation of the labour market (key actors, hiring and firing regulations, level of informality, working conditions) or the mode of acquisition of skills (education systems and values) influence the choice of approaches.
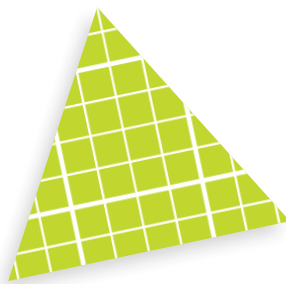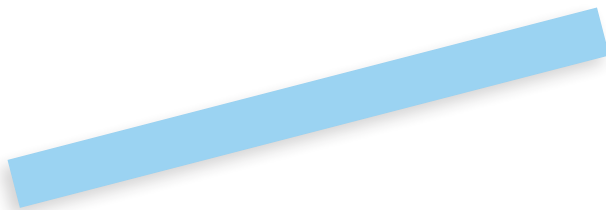
Box 11. Cultural context in Japan

Japan, during long-term use of foresights, developed a considerable 'foresight culture'. Foresight and its results become widely known and used for various purposes at all levels (from national policies to individual institutions, including stakeholders in R&D and education).

Japan has built its economic success predominantly on a skilled population, government-industry cooperation and intensive science and technology development, mainly within technology-based industries. It has a culture of employees staying with one employer for a long time, if not for life, which can result in a relatively less flexible labour market and education system. Individual companies are motivated to invest in the development of their workforce and draw benefits from various foresight exercises.

Foresight methodology choices are related to the Japanese cultural context. Anonymous methods such as Delphi, where the respondents' answers cannot be influenced by factors such as deference to staff seniority, are preferred over exercises that include face-to-face contact.

The results of the regular extensive foresight exercises, with a Delphi method at their core, carried out for the Japanese government, are regularly used by a variety of stakeholders from both the public and private sectors. Since the 8th S&T foresight in 2003--04 the results have also been used as a direct input for S&T and R&D policy formulation (the science and technology basic plan). Individual institutions also draw their plans from the national foresight results. Various other foresight (as well as other future-looking) activities are undertaken in Japan, ranging from sector foresight and meso-level exercises to specific industrial association foresight and micro-level foresight within individual companies.

Often it is stressed that in Japanese foresight culture the main value of the foresight is seen not only in the direct outputs like subsequent policies, but in the process itself, expressed as the 'five Cs': communication, concentration on the longer term, coordination, consensus and commitment (UNIDO, 2005, p. 11). From this point of view, education, other policies and individual companies directly or indirectly benefit from foresights, even if no direct regular institutional linkage is established.

Sources: Georghiou et al. (2008); NISTEP (2010); Cuhls (n.d.).

4.1.6. Institutional background

Adequate institutional infrastructure is essential for producing successful foresight results and corresponding responses. This covers not only institutions that sponsor or promote foresight activities (usually central or local governments and their agencies) but also relevant stakeholders (in particular employers and their associations, research centres, sector bodies, employees and their representative bodies, education and training institutions and others) who are possibly engaged or committed to such activities.

A lack of adequate institutional framework can mean a need to develop a consensus on reforms of existing institutions or development of new ones, which becomes a challenging issue. Establishing new institutions may take a long time. Partnerships and networking are often crucial contributors to success.

Existing institutional infrastructure and capability in a country affect the potential application of particular approaches. Those involved need to have the capability not only to produce foresight results but also to transform them into practical policies, programmes and measures at different levels. This is a limiting factor for many countries that would be able to produce foresight outcomes in some way (sponsored by international programmes, for example) but are likely to fail in producing a policy response due to weak institutions (Georghiou and da Fonseca, 2009).

4.1.7. Resources

Resources that are needed to perform foresight exercises include not only funds but also an existing statistical infrastructure, previous research or human resources with relevant knowledge and expertise. The quality and availability of these resources influence every foresight activity.

4.2. Success factors

Cases considered in the worldwide review of skill foresight approaches suggest that a number of common factors are found in successful cases. These are generalised key conditions for the success of skill foresight activities in every country.

4.2.1. Setting reasonable goals and scope of activities

For countries beginning to develop skills foresight approaches it is essential to set a reasonable scope of activities. Experience in various countries shows that considerable, if more modest, progress can be made using elements of good practice rather than an ambitious, large-scale programme. Setting goals and scope should be based on an initial assessment of country context which reveals the main opportunities and barriers.

4.2.2. Adequate institutional framework

Having an adequate institutional framework in place is a key success element. Countries that are able to use an existing framework seem to gain a considerable advantage. Some countries have a long history of evolution of organisations involved in skills, education and training development and policy. This has shaped the way skill needs are anticipated, and how possible skills mismatches can be dealt with. The case of Brazil shows (see annex) that the institution involved in skill anticipation (SENAI) has an extensive network of branches across the country, established over several decades. It is obviously easier to build on existing structures than to reach a consensus on the reform and development of new ones, which may take years. Usually, the framework comprises well-established institutions along with those that have been recently created in response to new challenges.
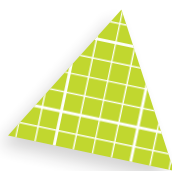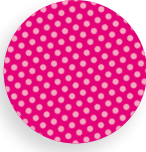
Box 12.   Institutional framework in Russia

Skills foresight activities in Russia are sponsored by two government structures: one well established and a second recently created to promote new business, young professionals and social projects.

1.   The Ministry of Education and Science of the Russian Federation launched a study of demand for new skills and competencies in high-technology industries as a part of its third science and technology foresight of the Russian Federation.

2.   The Strategic Initiatives Agency (established in 2011) has launched the Competency 2030 foresight as part of its initiative to create a national system of qualifications and competencies. This is a comprehensive project coordinated through the roadmap that involves activities undertaken by the Ministry of Economic Development, Ministry of Labour, Ministry of Education and Science, Ministry of Telecommunication and Mass Media, and others.

The Moscow School of Management Skolkovo (established in 2006) has been responsible for the execution of both projects. The scope of the project for the Ministry of Education and Science involved key high-tech sectors, taking in biotechnology (including agriculture and food industry applications), healthcare, ground transportation systems, aerospace, energy generation and transmission, information and telecommunications, extraction and processing of mineral resources, environmental protection and waste management. Additional sectors for the Strategic Initiatives Agency project involved construction, finance, education, government and public services.

Source: Annex, case study on Russia.

More information on the role of social dialogue and stakeholders' involvement and institutional setting in anticipating and matching skills are discussed in Volumes 1 and 3.

4.2.3.   Engaged stakeholders

Crossing disciplinary boundaries is essential to be able to address emerging real-world problems. The involvement of a wide pool of expertise, and often of stakeholders more generally, is needed to access relevant knowledge, to engage more participants in the policy process, and to establish networks for coordinating action and sharing information. Experience from various countries shows commitment from stakeholders is necessary: this does not mean that all stakeholders must be engaged, but for skills forecast the involvement of industry (employers) is essential. The SENAI system in Brazil is managed by an executive group formed by SENAI technical representatives, academia and business representatives who are both the producers and users of the information generated.

4.2.4.   Availability of resources

While the issue of insufficient financial resources can be partially resolved by sharing costs in international foresight programmes or reducing the scope of activities, lack of expertise (across institutions involved) and statistical data are more difficult to resolve in a short time. Networking and knowledge transfer from abroad can help overcome expertise deficiencies. Successful foresight exercises are able to balance available resources and expected outcomes.
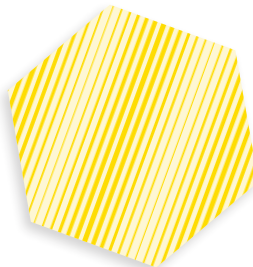
4.2.5. Choice of methods

The choice of methods should reflect country contexts, the foresight exercise focus, and the nature of the methods. International surveys have revealed that in Europe and North America, in circumstances where stakeholders have longer experience in participatory social dialogue, actors prefer face-to-face forums such as expert panels and workshops. In Asia, more anonymous methods, such as a Delphi, are preferred. There is no prescription for an optimum method mix but rarely is a single method used.

4.2.6. Effective dissemination of results

The foresight results should support informed decision-making by the target audience, so an effective mechanism for delivering results is a key element. The SENAI Thematic Antenna in Brazil is a workshop-like event where the executive group discusses the outcomes and generates recommendations for SENAI in relation to vocational training and provision of technical and technological services for the sector in focus. Results are ultimately made available to the target audience through the website and fed into the monitoring process to support SENAI in developing skills strategies.

4.3. Building foresight culture

The country cases considered here show continuing efforts have to be made to ensure the long-term success of foresight activities. Such efforts can create a foresight culture, an environment in which foresight exercises produce meaningful results, inform decisions and initiate corresponding responses.

A foresight programme/project is a time and resource-limited exercise which is only one step in building the required culture. Isolated activities with little follow-up tend to have limited success, so broader support activities/processes should be also considered:

(a) raising awareness of the importance of foresight in improving a country's economic and social situation. Awareness-raising activity should help to build foresight into the thinking of future generations of decision- and policy-makers. This can be done through conferences, forums, publications, electronic books, the Internet and the media. Promotional materials and events should familiarise stakeholders with the concept, the practice and the results of foresight activities. Special attention should be given to motivating industry to participate in foresight initiatives as part of a general demonstration of the value of foresight results to stakeholders;

(b) developing capacities and adapting foresight tools to a country-specific context. This involves improving the skills of foresight practitioners through courses, workshops, seminars, fellowships and study tours. The involvement of and the support for national centres of excellence on foresight process, which could be mobilised for the preparation of foresight studies, is needed. Making use of exchange programmes with regional centres and institutions in other regions and engaging international experts on foresight and relevant areas of knowledge are also appropriate actions. Practitioners should be supported in developing and adapting foresight tools to a country-specific context and in gaining knowledge and experience to ensure good foresight products are created;
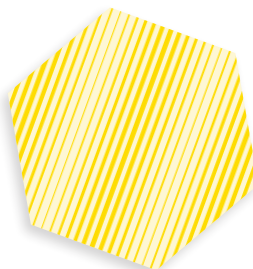
(c) undertaking foresight exercises for selected areas or themes with proper dissemination of results. This involves conducting selected foresight studies as cases to demonstrate the applicability of foresight approaches and their added value for the development of national and regional policies;

(d) strengthening national knowledge and the capacity to use foresight for designing and improving policies and strategies. More foresight exercises create a more solid knowledge base for guiding current decisions towards creating the desired future. To take full advantage of foresight results it is important to support their delivery to corresponding decision-makers.

Stakeholders should be motivated to adopt common foresight objectives and aided to articulate foresight needs: this demands awareness and knowledge. Setting up appropriate organisational structures for foresight programmes helps generate consensus on programme focus, including goals, methodologies, infrastructure and management.

Since foresight results should feed into decision-making processes (policy cycle), developing channels to deliver the results to target audiences is necessary. These includes individuals making career choices, practitioners in education, training and skill development, and those involved in labour market management systems: all those who know what is going on in the labour market and can see how the information gained can best be translated into relevant policy actions and other decisions. Relevant organisational structures foster a sense of ownership and make implementation of results easier.

4.4. Questions on preparation and implementation of a foresight exercise

This section offers an overview of some typical questions asked when deciding about the application of a foresight exercise and during the course of it.

Some of the following questions are extracted from the annex, and information about typical issues is taken from a set of presentations given during the ILO-Skolkovo (Moscow School of Management Skolkovo) International expert workshop 'Using technology foresights for identifying future skills needs' held in July 2013. Another useful source of typical questions about foresight is the FOREN network's *Practical guide to regional foresight* (JRC-IPTS et al., 2001) although this is primarily aimed at the regional level and is not focused on skills anticipation. What it offers can be regarded as generally applicable in foresight exercises and relevant to future skills and competencies foresight.

There are two main groups of questions: general items to think about before beginning the foresight exercise and those related directly to the process.

To which issues can a foresight exercise be applied?

While most often applied to 'hard' scientific and industrial topics, foresight can be applied more widely, as with skills and competencies, although practical examples of these exercises are not too common.

The exercise should determine what challenges the country/region will face over the coming decades: these may be technical (buildings/location/discovery of new sources of energy, building of road networks) or
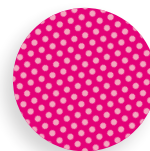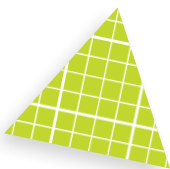
social (ageing of society, baby boom, greening economy). The need for the skills foresight is also part of changing technologies, processes and managerial approaches in the economy resulting from technological progress and social innovations, increasing global competition for consumer markets, and efforts to modernise industries and to launch the 'knowledge economy'.

New challenges and activities are frequently accompanied by labour market changes expressed as changes in occupation structure, working tasks and skills. There are tasks that can be resolved with existing skills and knowledge, those that require new skills and knowledge (hence the demand for new competencies) and those that are no longer needed. The foresight should show which skills the country needs to develop over the mid or long term and to determine how these skills can be generated by the education and training system. This means assessing if the existing capacity of education (initial and continuing) is up to developing newly-detected professions, working tasks and skills.

What are the main rationales for foresight activities?

(a) To inform policy-making, so that decisions taken by key actors in commissioning bodies reflect longer-term developments and how these are liable to interact with current policy decisions. Often a foresight exercise will be stimulated by the need to take a particular decision, but the knowledge developed, and the foresight capabilities that have hopefully been embedded in the organisation, should have a wider significance.

(b) To help build networks among the people centrally involved with shaping the future of a particular topic. They will be brought together to work on their visions and assessments of the future. The purpose of this is to help them become better able

collectively to understand the challenges and opportunities that they are liable to confront, and the strategies and objectives that others might pursue.

(c) To develop capabilities to support the development of a 'foresight culture'. The aim of this is for people of various kinds to be able to define and embark upon their own foresight activities, to forge their own foresight networks.

In practice, a mixture of these three reasons is often in play. The third rationale is probably the one that has been slowest to be recognised as a practical goal, but it is often very relevant. There may also be other goals that stimulate interest in foresight; it may start from a national exercise or an effort to make the region's voice heard within the context of such an exercise (see annex, especially sections on the main challenges and policy objectives of case studies).

When done well, foresight is more a process than an academic study; involvement and mobilisation of the actors and the use of social dialogue with the private sector are key success factors and can be seen as an objectives in themselves. Some typical objectives set for foresight can be plotted using the axes:

• the mobilisation of actors and consensus building;

• the ability to inform and shape policy-making and decision-making processes.

How can formal methods be used in foresight?

Any foresight exercise involves a range of methods. Some of these relate to the management of the process, the securing of requisite support from its constituencies, and achieving results among its intended 'users'. Other methods are used for the generation of informed visions of long-term futures, and various formal techniques are employed for this purpose [44].

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[44] More detail on these methods is provided in Chapter 2 and in the annex, especially in the sections on key institutions, processes, approaches, methodologies and results.
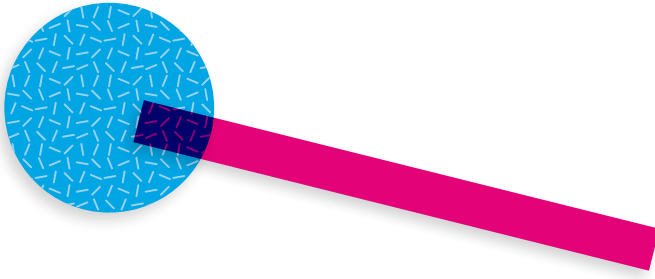
How can I go about identifying the foresight approach appropriate for my situation?

The issue here is one of choosing the appropriate balance of approaches, and this will be influenced by the problems at stake, the resources at hand, and the political context.

How could foresight be 'positioned' *vis-à-vis* existing policies and programmes?

Foresight activities can be arranged as relatively 'stand-alone' exercises organised by public authorities or they can be embedded in existing policies, programmes and strategy-making processes.

What would be the most suitable time horizon for the foresight to adopt?

Time horizons tend to vary from five years up to 20 years, mostly reflecting the varying identities of project beneficiaries, expected foresight products and processes.

How long will it take to conduct a foresight exercise?

An exercise lasts typically between six months and three years.

How much will it cost?

Costs can vary. They will depend on location of activities, scope of the exercise, number of people in the project management team, organisation of events, and approach selected.

Who should be involved in a foresight exercise?

This totally depends on the specific foresight objectives, but actors such as governments, universities, businesses, chambers of commerce, employers' and industry associations, trade unions, media, and NGOs are normally involved. In the case of skills key actors should be ministries of education, labour, social affairs, economic and finance, as well as government agencies (public employment services, the agencies for vocational education and training and for higher education), the research community, social partners, and civil society organisations (see annex, especially the sections on key institutions, processes, approaches, methodologies and the results of case studies).
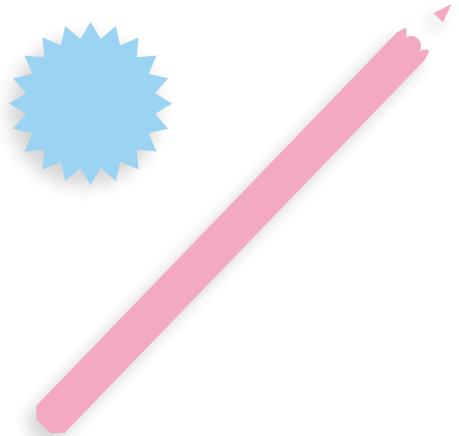
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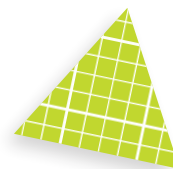
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http://www.thefuturesacademy.ie/

JRC-IPTS, For-Learn online foresight guide
http://forlearn.jrc.ec.europa.eu/guide/0_home/index.htm

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New skills for new jobs initiative
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http://www.techforesight.ca/description.html

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http://www.unido.org/foresight.html

World future society
http://www.wfs.org/node/421

Part B:
Skills forecasts

Chapter 5.
Introduction to skills forecasts

In the first part of the guide, qualitative methods of skills anticipation have been thoroughly reviewed. Methodologies have been discussed and implementation and its pitfalls have also been described. While qualitative approaches have their merit, a quantitative approach to skills forecasting can also be useful. Though qualitative approaches are usually less demanding in terms of input and budget requirements, quantitative approaches excel when complex interactions are to be examined, or comparability based on a fixed methodology is crucial in repeated forecasting and use of results.

In the following sections, we aim to provide a brief overview of skills forecasting and to point readers towards additional literature where they can find more information about the huge amount of work going on in this area ([45]).

Skills forecasting is not an attempt to plan the system from the top down. It aims to inform all participants in the labour market and education and training arena, to help make markets work better. Some have argued that systematic anticipation of changing skill needs is unnecessary and impossible and that nobody can predict the future with certainty. But everybody can prepare or plan for it, including governments, employers, education institutions and individuals. To do this involves some element of forecasting: either implicitly or explicitly. In this sense, not only is forecasting possible, it is also inevitable. The only meaningful questions are how it should be undertaken, by whom, and with what end in mind. The revealed preference of governments worldwide suggests that there is general acceptance of the case for carrying out such work as a 'public good'.

While it is now generally agreed that in a market economy it is not possible to make precise predictions that can be used for detailed 'manpower planning', the need to make strategic plans and choices which can influence and shape the future path taken by the economy and labour market is widely accepted. Such plans need to be guided by robust labour market information and analysis, including a forward-looking element. This needs to be based on regular, systematic and quantitative approaches to forecasting and scenario development.

Skills are a key part of the infrastructure of the economy; the choices made by policy-makers, enterprises and individuals on investment in education and skills can help to determine the path the economy takes. These individual choices also need to be guided by good labour market information and analysis.

It is telling that the US, one of the most capitalist economies in the world, devotes more resources to this activity than anywhere else. The approach is backed up by huge investment in labour market information, including forecasting, aimed at ensuring that students are well informed about the choices they face. Europe as a whole has some way to go to catch up, although there are many examples of good practice in individual Member States.
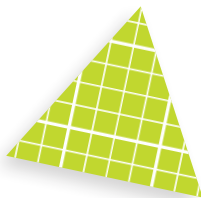
([45]) In this text we incorporate experience and information from the programme of research led by the Warwick Institute for Employment Research, funded by Cedefop. This report is only one part of the project. As a whole, the project focuses on the implications of structural changes in European economies and labour markets on the demand for and supply of formal qualifications (Cedefop, 2010).

The experience of the US and other countries across the world suggests that forecasting can provide systematic analysis of the implications of continuing past and current trends and patterns of behaviour. It can help to map out different scenarios, based on alternative assumptions, which can form a basis for intelligent and informed debate and further research, as well as helping to inform individuals making career decisions.

Although there is strong evidence of causal links between investment in education, training and skills and economic success (both at the whole economy level and for individuals), there is no guarantee of a positive return. It is crucial to invest in the right areas. This highlights the importance of understanding where the best opportunities will arise.

Box 13. Rationale for skills projections

The rationale for producing regular and detailed projections includes:
- filling existing information deficits and preventing future labour market imbalances;
- informing various actors on future labour market needs, as an aid to their choices and decision-making;
- supporting policy-making at national and European level in employment and social protection, lifelong learning, guidance and counselling and migration.

Answering key questions:
- in which sectors and occupations will employment be growing?
- for which qualifications will demand increase or decrease?
- what about replacement needs?
- how will this compare with supply?

5.1. Skills forecasting: for whom?

There are many different audiences for skills analysis and forecasting, and their specific and detailed needs for labour market information and analysis may be very different. In the current guide we focus on the longer time horizons of 5- to 20-year forecasts. While shorter-term forecasts have a merit of their own, we will not discuss them in this guide extensively. The discussion will partly be informative for other time horizons as well.

A key set of questions to be addressed when assessing such needs and systems are:

(a) when: what is the timeframe over which the skills forecast will be performed and for how long;

(b) by whom (funding and execution): who is the funding body of the skills forecast, and by whom is the skills forecast executed;

(c) for whom: what is the target group or the goal of the skills forecast;

(d) how: which approach and/or methodology is chosen to generate and present the skills forecast.
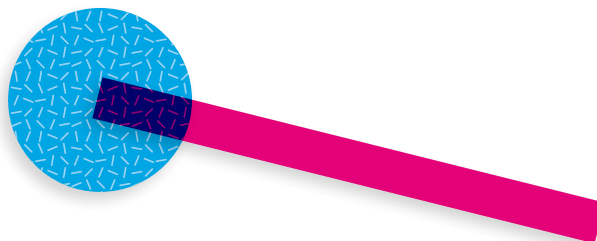
The main audiences include:

(a) government, at national and regional level (policy-makers);

(b) stakeholders, including local bodies, industry training organisations, employers, trade unions, education and training institutions, and careers guidance organisations;

(c) individuals making occupation choices.

The interests of the different audiences may be very different. They include:

(a) links to more general economic policy and analysis, including productivity and growth;

(b) occupation demand: future employment levels by occupation/skill;

(c) replacement demands: job openings (recognising the need to replace those leaving);

(d) education and training requirements: qualifications typically needed;

(e) supply/demand balances;

(f) terms and conditions of employment (pay).

What is done and how it is done, therefore, depends at least in part on who it is being done for and why. Different audiences have very different requirements for both detail and general content. Policy-makers are more interested in overall supply/demand balances and the general areas where investment in skills is needed. Training providers and individuals are interested in much more detailed information about prospects in particular areas.

A particular ministry may have special requirements. For example, the ministry of the economy may have more interest in developing alternative scenarios showing links to macroeconomic drivers and policy interventions.

Limited resources mean that the main national projections are intended to serve many different users and purposes. While this cuts costs, it may mean compromises in terms of meeting the specific needs of different users. We will be discussing best practices in most cases, which show what can be achieved; this does not imply the simplification of modules or a combination of quantitative and qualitative approaches (Part A). On the quantitative side, we have tried to include alternative approaches that might supplement best practices whenever this was straightforward to do.

5.2. Duration of forecast

The chosen duration of the forecast is often determined by the specific goals. Long-term planning and insights into developments in the labour market by sectors and occupations, qualification and skills demand, are often well served by longer time horizons (10–20 years). More specific questions on information regarding study choice might be better served by more detailed, but mid-term (5-9 years), forecasts. Employment service providers are often interested in short-term detailed forecasts which are not discussed in detail in this volume of the guide (see Volume 4).

Generally, the longer the forecasting period, the less detailed and precise the forecast necessarily becomes. It is useful in identifying important developments in the labour market and long-term shortages that policy might address, but less so for immediate study choices. In the latter case, students are interested in an answer to the question: what qualification will help me find a job quickly after I graduate?

Both are necessarily interrelated. While it might be true, that longer-term forecasts might not be able to isolate certain developments to within a particular year, the outcomes are likely to be important even for study choices, as graduates will eventually not only find a first job, but also keep being employed over their entire working life.
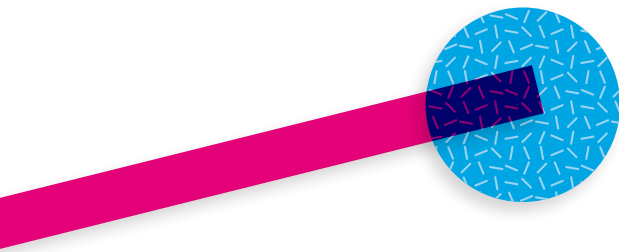
5.3. A brief history of labour market forecasting

One early step in labour market forecasting was the work around the Mediterranean regional project in the early 1960s (Parnes, 1962; OECD, 1965). The aim of these initiatives was to understand the changing economic structures in six Mediterranean countries: Greece, Italy, Portugal, Spain, Turkey and Yugoslavia. It involved outlining detailed educational requirements that would stimulate desired growth through the optimum planning of education output. Around the same time, similar projects were initiated elsewhere; all involved the belief that detailed education planning and manpower analysis could provide detailed forecasts of required manpower.

Path-breaking work was done at the US Bureau of Labor Statistics. For more than 50 years, they worked on projections that helped to highlight the future challenges of the labour market. The first projection of the labour force, industry output and employment, and occupational employment and job openings, was presented as early as 1966.

Out of these detailed manpower planning models and approaches developed, in the 1980s, a much more modest analysis of expected future demand and supply of skills, mainly used for policy planning and information provision (Van Eijs, 1994). While the models build on similar data infrastructures, the methodology, outcome and interpretation was more careful. Supply and demand were modelled to interact to some degree, and resulting imbalances were not interpreted at face value or in exact numbers. Different approaches to the confrontation and presentation of supply/demand outcomes evolved in different countries, but the common factor in most countries was the emphasis on uncovering imbalances rather than predicting exact requirements.

The usefulness of skills forecasts nowadays should not be tested on their direct predictive power but in terms of how useful the information is in guiding the decision-makers to tackle future expected imbalances. The critical point is to evaluate whether the information provision in itself provides sufficient value for the costs of establishing these models.

5.4. Best practices: when to use quantitative skills forecasts

We believe that quantitative approaches to skills anticipation have helped to shape the analysis of future skills needs. We use what we consider best practices as a guideline in this report and, in doing so, we will also mention and discuss alternatives. These discussions will necessarily lack the depth and detail that we can provide for methodology that we have adopted ourselves.

Wilson (2008; 2012) et al., 2004) has provided general reviews of quantitative approaches to skills anticipation, drawing lessons from work in the UK and at pan-European level. The reviews provide a summary of the models, tools and other approaches used to help identify future skill needs across the world, including an assessment of their strengths and weaknesses.

The conclusions of such reviews are that 'best practice' worldwide involves quantitative methods, based on the use of large-scale, multisectoral models to produce a comprehensive overview of how structural economic and technological changes are affecting the demand for skills. This is not the only approach to skills anticipation: such methods need to be complemented by other quantitative and more qualitative approaches, especially where data for building quantitative models are limited. However, quantitative projections based on such methods can be a cornerstone in developing systematic approaches, and limitations in data or models can be overcome by using the qualitative methods discussed in Part A of this guide.

5.4.1. Limitations of quantitative models

It is important to recognise what such quantitative models can and cannot do. On the positive side, projections can:

(a) help to make assumptions about the future explicit and transparent;

(b) help to enforce systematic and logical thinking;

(c) act as a focus for intelligent debate;

(d) provide a useful counterfactual to assess policy impacts (what would have happened in the absence of the policy intervention).

But they cannot provide:

(a) mechanistic 'manpower' planning;

(b) precise indications of education and training requirements.

Sophisticated econometric techniques can be used where data are adequate. This is a feature of much macroeconomic modelling. The implications for occupations and qualifications are then developed in other modules using extrapolative techniques, for example modelling and projecting employment shares within industries for occupations and qualifications.

Such results are intended to provide a sound statistical foundation for the deliberations of all those with an interest in the supply of, and demand for, skills. This includes individuals, employers, and education and training providers, as well as the various agencies and departments of government. While the future cannot be predicted with precision or certainty, all the participants in the labour market make plans for it, even if these are simply based on the default assumption that the future will be the same as the past. The rationale behind such projections is that a comprehensive, systematic, consistent and transparent set of projections can help to inform everyone about the world they are likely to face.

The views presented are not the only possible future. They represent a benchmark for debate and reflection and an aid to informing policy development. The detailed projections present a carefully considered view of what the future might look like, assuming that past patterns of behaviour and performance are continued over the longer term.

The results should be regarded as indicative of general trends and orders of magnitude and are not intended to be prescriptive. If policies and patterns of behaviour are changed, then alternative (perhaps more desirable) futures can result.

Combining quantitative forecasts with foresighting techniques (Part A) allows elaboration on the strengths and weaknesses of quantitative forecasts. By including alternative scenarios and varying underlying assumptions, different forecasts can be produced. These variants allow deeper analysis of the underlying factors influencing an economy.

Quantitative models are regarded as essential to obtain a robust and consistent sectoral employment scenario, which is the starting point for any comprehensive assessment of changing skill needs.

The advantages of such an approach include:

(a) the sectoral and other detail it provides;

(b) the fact that it is typically comprehensive, covering the whole economy;

(c) logical consistency;

(d) the imposition of accounting constraints;
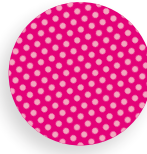
(e) the recognition of economic constraints and influences;

(f) the fact that it helps make underlying assumptions explicit;

(g) consistent scenarios across all sectors.

Such methods have some disadvantages and problems, including:

(a) technical limitations, within fixed resource limits;

(b) limits to current understandings of the way labour markets work;

(c) the possibly limited relevance of the past, such models being based on an assumption of a continuation of past patterns of behaviour;

(d) the data requirements of quantitative modelling approaches are substantial: long time series of consistent sectoral data on a range of economic and labour market indicators, especially employment, lie at the heart of any multisectoral modelling approach to assessing changing skill needs, ideally linked to other economic indicators within a system of national accounts. They also require many years of substantial investment;

(e) data limitations: often the data used to build models were not collected with modelling in mind;

(f) resource costs of development and maintenance.

Quantitative models should not, therefore, be seen as a panacea, but in most countries that conduct regular national assessments of future occupational and skill requirements they are regarded as an essential cornerstone. Such models are increasingly being adopted in developing, as well as developed, countries, as the availability of data and the capacity for model building improves.

Nobody can predict with precision the demand for, or supply of skills. Nor is the future predetermined. However, many trends are robust and these can be used to inform all those involved about the world they are likely to face.

Data quality is a key issue: results from such models cannot be more robust than the data upon which they are based.

The development and use of quantitative models is a resource-intensive process, requiring substantial prior investments in data and analysis, often taking many years. However, it is argued here that by building on existing models and methods, it is possible to develop something quite quickly that can help to begin the process of building a robust approach to such requirements.

Several other tried and tested methods complement the quantitative approaches and are less dependent upon such data; these can be implemented in a much shorter time. However, there is no substitute for robust quantitative information on the current position and trends.
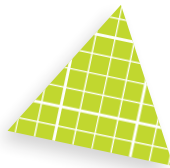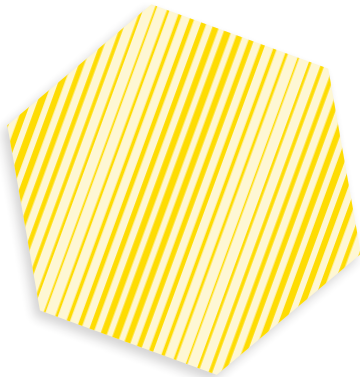
Chapter 6.
General approaches in skills forecasting

There have been many different approaches to anticipating changing skill needs worldwide. These have tended to reflect perceptions of what is desirable, as well as the practical limitations of what is feasible. Both of these have changed substantially over the past 50 years.

From the earliest attempts, those engaged in such work have adopted model-based, quantitative methods wherever possible, simply because quantitative results have been seen as a key output required by potential users. The use of formal models has been advocated on various grounds, as detailed below. However, the merits of alternative, more qualitative methods have also been recognised (Lindley, 1994).

The most frequently used approaches to anticipating future skill needs can be grouped under four main headings:

(a) ask employers (such as employer skill surveys – see Volume 5);

(b) quantitative models (formal, national-level, quantitative, model-based projections);

(c) sectoral studies (see Volume 3);

(d) primarily qualitative methods (focus groups/ roundtables and other Delphi-style methods, and scenario development. These may include some quantitative aspects but are generally more qualitative – see Part A of this volume).

Each of these approaches has its own strengths and weaknesses which are summarised in Table 15.

Table 15.   Some alternative approaches to anticipating skill requirements

Alternative approaches	Advantages	Disadvantages
Surveys of employers or other groups, asking about skill deficiencies and skill gaps	Direct 'user/customer' involvement Focuses on behaviour	May be very subjective Inconsistent Myopic Can focus on the margins too easily (i.e. current vacancies) rather than on skill gaps within the current workforce
Formal, national-level, quantitative, model-based projections	Comprehensive Consistent Transparent Quantitative	Data-hungry Costly Not everything can be quantified May give a misleading impression of precision
Ad hoc sectoral or occupational studies (using a variety of quantitative (model-based) and qualitative tools)	Strong on sectoral specifics	Partial Can be inconsistent across sectors
Focus groups/roundtables and other Delphi style methods	Holistic Direct 'user/customer' involvement	Non-systematic Can be inconsistent Can be very subjective

6.1.   Quantitative modelling

The basic methods adopted for quantitative modelling can be classified under the following headings:

(a) extrapolation of past trends;

(b) more complex time series methods;

(c) introducing behavioural content.

Extrapolative techniques are often used, especially where only very limited time series information is available. In many cases, only one or two observations are available on occupation structure and this clearly limits the sophistication of what can be done! Where more time series observations are available, much more sophisticated analysis is possible; this attempts to find patterns in a time series that can be used to predict its future path. Such approaches are widely used in the business and financial world, although they are much better at predicting short-term change than longer-term patterns.

History suggests that most linear (or more complex) trend patterns eventually come to an end and so should not be relied upon for medium- to long-term forecasting. Behavioural analysis is an attempt to move beyond patterns in observed time series data and to provide some understanding of how it is that these patterns have arisen and, more important, why they may change in the future. Analysis draws on disciplines such as economics and sociology for an understanding of what influences the behaviour of the key actors in the economy and how this is reflected in the main economic and social indicators that can be measured [46].

Such understanding finds representation in computerised 'models', which take the form of algebraic equations linking key variables. A model is an attempt to provide a simplified representation of reality that can help the researcher understand the phenomenon of interest (in this case changing patterns in demand for skills in the labour market). The idea of engineers building models in order to test out their ideas, for example testing model aircrafts in wind tunnels, is familiar. Models in the social sciences suit a biological analogy better than an engineering one; as an example, scientists have built models of dinosaurs in order to try to understand how they could fly. Social scientists attempting to understand how societies and economies work face problems such as:

(a) lack of fixed laboratory conditions;

(b) lack of good experimental data (they can only observe outcomes).

Social science models are typically built using quite sophisticated statistical and econometric techniques. They are based on data drawn largely from official sources, including national accounts and related estimates of employment based on surveys of employers and of households.

6.2. Qualitative methods

Most of the qualitative approaches have been described in Part A of this guide. They include the use of in-depth interviews with key stakeholders, including employers, detailed case studies (especially of particular sectors), scenario development, focus groups, roundtable discussions and similar mechanisms. These enable 'soft' qualitative data to be incorporated into analysis and thinking about future skill needs alongside the 'harder' statistical information on which most quantitative analysis is based (see especially Chapter 2 in which these methods are discussed in depth).

6.3. Combining quantitative and qualitative methods

Bringing together and combining quantitative and qualitative methods is desirable in skills anticipation. Quantitative results can inform qualitative research and vice versa. Such holistic approaches, along with innovative solutions in research and analysis, can better cater for the time gap between the actual change in demand and the policy and implementation response.

[46] Expected paradigm shifts or historic data series that are deemed not to be adequate to estimate or feed into the quantitative model could be supplemented by qualitative methods such as scenarios (Chapter 2) and their translation into quantitative effects. Vogler-Ludwig et al. (2013) use such a method.

Chapter 7.
Data

It is hard to predict the future without an understanding of either the past or the present. Data, especially labour market data, are crucial to do skills forecasting. In the following, we describe the key data requirements for quantitative modelling as it is advocated in this report. In some sense, it does not matter whether the data are collected on a regional, national or transnational level, if that is the level in which the forecast is to be made. In general, it is assumed that the data are collected on a national level.

7.1. Key data

The following list summarises the key data that can be used for skills forecasting. The degree and duration for which these data are necessary depend on the specific series and aims (see individual descriptions of the data):

(a) national accounts time series on output by sector and factor inputs on capital and, more important, labour. More detailed data on these macroeconomic figures, as well as detailed data on sector, employment and labour market participation rates by age and gender, and price and wage information, help specify many aspects of the macroeconomic model in more detail;

(b) historic data on employment by occupation, education and industry. These are usually collected in either labour force surveys (LFS), as with the surveys underlying the EU-LFS, or as part of a (partial) census. As many aspects of the estimations are determined using historic data to identify both relationships and time trends, longer time series with many waves are preferred; the normal case would be detailed data based on an annual labour force survey. The estimation of

expansion demand basically determines the allocation of sector employment demand across occupations, for which we need information on the occupation by sector employment and development;

(c) historic data on employment by occupation and age-gender groups is necessary for the estimation of replacement demand. Ideally, individual changes (gross flows) of workers would be observed, but repeated cross-sections with employment in occupations by age-gender groups are mostly used to identify net flows to estimate replacement demand;

(d) employment by occupation and qualification helps in bringing together supply and demand. Having historic information on the development of this relationship helps to identify and interpret the reactions of the economy to imbalances in supply and demand;

(e) historic data on population development. Often, these are already factored into population forecasts, which are important for the labour supply forecast;

(f) consistent information on participation and graduation in education is ideal to model more detailed supply processes. However, these data are often at least partly missing or historic experience is severely disturbed by administrative changes. This can be in terms of financing education, which is important for opportunities and decisions on enrolling in education, but also in terms of the types of degree. Examples are the introduction of the bachelor and master system in continental Europe, for which there is no direct (data) precedence.
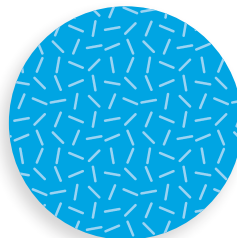
7.2. Data collection

Surveys are the most common form in which the key data described above are collected. Data quality needs to be good for reliable forecasts. Many countries already have some form of labour force survey, a good source for the key numbers and relationships necessary to generate skills forecasts. Labour market surveys usually sample a group of respondents to generate statistics that are sufficiently reliable and robust [47].

Census data usually take stock of the entire population in a country. Given the magnitude of this task, a census cannot be repeated as often as surveys. In some cases a country uses a sample to fill information gaps between full censuses. A census is often less detailed about qualifications and labour market information, but could supply the basic information to enable skills forecasts if they cover information on employment by occupation and sector as well as demographic information on age, gender and qualifications.

Employer surveys usually collect information on employment within firms, qualifications, skills and/or task requirements, and firm- or sector-related information. They have the advantage that information about demand by skills or qualifications can be identified directly. However, they are not commonly used or integrated as a key data source in quantitative labour market forecasts.

New data sources that add to the above modes of data collection come from the increasing ease with which administrative data that are collected for a different purpose can be used. For example, the social security contributions or tax payments of workers in employment relationships are already collected in many countries in such a way that key information can be identified: the employment (numbers) by sector, age and gender. Adding or requiring additional information such as qualifications or occupation makes such administrative data useful for quantitative forecasts by detailed levels of occupation and qualification.

Other sources potentially useful in providing detailed information about skills or qualifications are various skills surveys. These usually sample groups of adult respondents and enquire about the utilisation of skills in different contexts. To be beneficial for quantitative forecasts these surveys need to be sampled by occupational group.

Data sources suitable for skills anticipation and matching are discussed in more detail in Volume 1.

7.2.1. Classifications

Classifications of sectors, qualifications and occupations are important in running quantitative forecasting models. These classifications allow the combining of different data sources and set the level to which forecasts can generally be made. If existing classifications do not reflect the level of detail to which a forecast is to be done, alternative classifications would need to be determined.

Within the European context, the international classifications for industry (NACE), occupations (ISCO) and education (ISCED) are used. These allow using the time series of the data under the assumption that the classification into the categories has not changed [48]. Changes in classification pose additional challenges to forecasting, as they usually introduce breaks in time series that have to be considered in the (estimation) models of the quantitative forecasts. Ideally, the classification change can be applied retrospectively to data that have been collected earlier, to have long time series using the new classification. In practice, this ideal case is not often observed.

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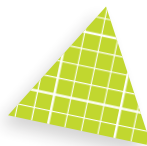
[47] The size of the sample to be drawn depends on the variation in the variables of interest. The more variation in the key variables and the more heterogeneous the population, the bigger the sample has to be. Many countries draw samples that come close to 1% of the working population. Using stratification along several key dimensions of the population allows scaling down the size of the sample.

[48] That this assumption is not always valid can be seen in the discussion on data quality of the Cedefop project. Shifts in the 'interpretation' of classifications can be found for many countries within the EU-LFS. For forecasting it can be important to identify those implicit breaks in data series and adjust them so that they do not interfere with the estimation methodology.

National data providers often do not adhere (directly) to international classifications. This allows them to introduce detail in aspects that are important for the economy – such as specific information on the vocational education and training qualifications in Germany that are not always easy to fit within the ISCED categories – but it poses the danger that the classifications cannot easily be compared.

Specific aspects of the use of standard classifications for skills analysis are also discussed in Volume 1.
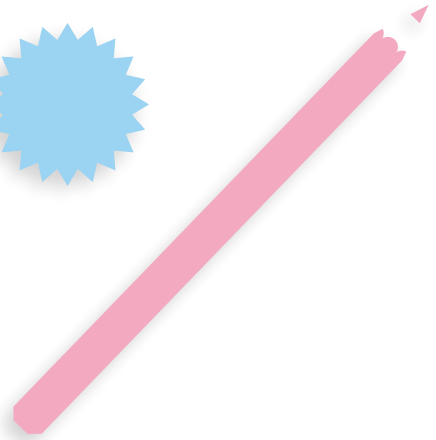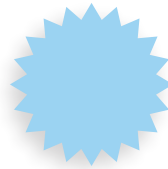
Chapter 8.
Modelling approaches

8.1. Macro models

A key building block in quantitative forecasting can be macro models. These models calculate the effects of changes in key parameters and endogenous reactions and feedback loops based on economic theory or estimates from historic data. They build models of key interactions in an economy by including those elements that are expected to drive the economy as a whole, and specifically the outcomes that the model has been developed for.

The advantage of macroeconomic models over econometric techniques of (trend) forecasting is in their ability to include key interactions. This also allows the researcher to 'run' the model to evaluate different scenarios (views) of the outcome of some key drivers of economic activity, or to include specific elements for which the outcome is of particular interest to the policy-maker (policy simulations).

Many established national and international macro models have been developed for various purposes. The Dutch Planning Office, for example, uses macroeconomic models to develop a short- to medium-term forecast and analyse the Dutch economy (Saffier II), the Athena model for short to long-term forecasts that include an analysis of sectors and form the basis for long-term scenarios, and Worldscan, the model used to investigate and forecast international issues such as European integration or climate change impacts.

Inforge is a macroeconomic model that is used to simulate developments on the German labour market and which has been used for labour market forecasts by the German Employment Services (Lutz et al., 2003).

8.1.1. The macro model for the Cedefop skills project: E3ME

E3ME is a well-established model of the European economy and labour market [49]. It delivers detailed projections of employment by sector and country and of the economically active labour force by age (and gender) that drive the more detailed skills modules. E3ME treats Europe as a multiregional area, with each country treated as a region within the whole. The entire system is covered for all sectors and regions (countries).

The model is based on empirical relationships and econometric estimation. The main data source is Eurostat and the model has recently been updated for NACE revision 2. The revised model distinguishes 69 industrial sectors (to be aggregated for presentation to around 40 industries). It is compatible with ESA-95 accounting classifications. Labour supply is split by gender and five-year age bands.

E3ME includes a detailed treatment of the labour market, with sets of equations for employment (treated as labour demand), labour supply, average earnings and hours worked. The equations for labour demand, wages and hours worked are estimated and solved for each economic sector, defined at NACE two-digit level. Labour participation rates are disaggregated by gender and five-year age band, and multiplied by Eurostat population data to obtain labour supply information.

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[49] The discussion here is based on the E3ME website (http://www.e3me.com). A full technical manual is also available on this website.

Employment is modelled using national accounts data, with a total headcount for each industry and country as a function of industry output, wages, hours worked, technological progress, and energy prices. Industry output is assumed to have a positive effect on employment, while the effect of higher wages and longer working hours is assumed to be negative. The effects of technical progress are ambiguous, as investment may create or replace labour; this will vary between sectors.

On the supply side, labour market participation is estimated as a rate between 0 and 1 for each gender/age group and country. Labour market participation is a function of output, wages, unemployment and benefit rates. Participation is assumed to be higher when output and wages are growing, but falls when unemployment is high, or social benefits create a disincentive to work. There is also a measure of economic structure and the relative size of the service sector of the economy; this has been found to be important in determining female participation rates. Participation rates determine the stock of employment available (by multiplying by working-age population, which is exogenous). Unemployment, both voluntary and involuntary, is calculated by taking the difference between labour supply and demand.

In E3ME, wages are determined by a complex union bargaining system that includes both worker productivity effects and prices and wage rates in the wider economy. Other important factors include unemployment, tax rates and cyclical effects. Generally it is assumed that higher prices and productivity will push up wage rates, but rising unemployment will reduce wages. A single average wage is estimated for each country and sector: estimates are a key input to both the employment equations and the price equations in E3ME. In the absence of growing output, rising wages will increase overall unit costs and industry prices. These prices may get passed on to other industries (through the input-output relationships), building up inflationary pressure.

Average working hours in each sector are determined by its position in the economic cycle and technological progress. The estimate of hours worked is an explanatory variable in the employment equation (see above). The number of hours worked is defined as an average across all workers in an industry and incorporates the effects of higher levels of part-time employment in certain regions and industries.

8.1.2. A model suitable for transition countries: Hermin

The structural Hermin model was developed by Bradley (2000). It represents a simplified version of the more complex multisector Hermes model, originally designed by the European Commission in the early 1980s for an international comparison of structural funds (community support framework) effects on the national economy (d'Alcantara and Italianer, 1982). The simplification in the Hermin model allows its use of this model in countries lacking statistical data (such as the pre-accession EU countries). The methodology is also suitable for modelling small open economies. The original Hermin model structure is composed of four main sectors (manufacturing, agriculture, market and non-market services) and contains both the supply and the demand side of the economy (Bradley et al., 1995; Barry et al., 2003).

In several applications modified model designs were introduced and comprised five main sectors: manufacturing, market services, construction, non-market services and agriculture. Such modified versions of the Hermin model have been used to evaluate national strategic reference frameworks effects in, for example, Czech Republic, Estonia, Romania, Slovenia (Bradley et al., 2005), and Slovakia (Kvetan et al., 2006). The Hermin model was initially developed to estimate effects resulting from the allocation of structural funds (Zaleski et al., 2004; Kvetan et al., 2006) and was further developed for analysis of different problems. The Hermin model should also be applied to long-term labour market forecasting based on the demand side of the economy.

The Hermin model framework focuses on key structural features of a cohesion-type economy, of which the following are important:

(a) the degree of economic openness, exposure to world trade, and response to external and internal shocks;

(b) the relative sizes and characteristics of traded and non-traded sectors, together with their development (factors such as production technology and structural change);

(c) the mechanisms of wage and price determination;

(d) the behaviour and flexibility of the labour market with the possible role of labour migration;

(e) the role of the public sector and the possible consequences of public debt accumulation, as well as the interactions between public and private sector trade-offs in public policies.

The Hermin model and its modifications were developed to analyse medium-term policy impacts of EU structural funds implementation. To fulfil this goal some basic assumptions need to be borne in mind:

(a) disaggregation into a small number of crucial sectors that allows identifying and modelling the key sector shifts in the economy over the future years of development;

(b) specification of the mechanisms through which an economy is connected to the external markets. The external (or world) economy is very important to the economic growth and convergence of lagging economies, through trade of goods and services, inflation transmission, migration and inflow of foreign direct investment;

(c) the need to recognise possible conflicts that may exist between the actual situation in the economy (captured in a Hermin model calibrated with the use of historical data) and the expected future development of the economy. Estimation of parameters based only on past data is likely to be inappropriate (even where it is feasible); it may be necessary to calibrate some parameters based on expert estimations and the existing current economic situation should be evaluated with caution.

To satisfy these requirements it is inevitable to evaluate the overall economic development of a given economy and to possess the necessary skills.

The Hermin model structure has proved its flexibility and applicability to many countries (ranging from developed to post-communist countries); it has been used for different types of analyses, ranging from evaluation of EU funds (Radvanský and Frank, 2010) to labour market analysis in Macedonia (FYROM). Current methodological progress is oriented towards regional application of the Hermin model, particularly to NUTS-2 Polish (Zaleski, 2009) and NUTS-3 Slovak regions.

8.2. Other economic modelling

Econometric forecasting modelling cannot progress much further without fundamental shifts in the availability and quality of data available. There are arguments for developing computable models to fill in some of the gaps where the existing data limit what can be estimated econometrically. For many years economists have been developing computable general equilibrium (CGE) models. These now fall into many different classes, including those that explicitly consider disequilibrium situations.
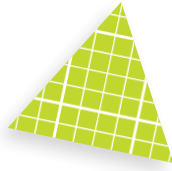
In the European project, Meagher et al. (2012) have demonstrated the feasibility of developing such CGE models, although the examples developed are neither general (considering just a small part of the skills demand and supply nexus) nor necessarily equilibrium-based (focusing on how the labour market adjusts to resolve imbalances). However, the CGE type approaches enable a much more in-depth examination of the key drivers of change in different sectors, and an understanding of the underlying reasons behind the quantitative decline or expansion of particular skills.

8.3.   Simpler models of employment change

Transition and developing countries often face problems with data availability and quality, in particular when longer time series are necessary. Less data-hungry models based on input-output tables or social accounting matrices can be useful in such cases.

Input-output models are simpler than those described above. Their purpose is not an economic forecast: they are not designed to project GDP but to model impacts of changes in final demand for products on the production of different sectors and on employment. They are used to demonstrate how a specific scenario on the demand side – for example higher demand for some products or services by households, a change in direct foreign investment, or a change in government spending – will influence the volume and structure of employment and, by implication, the demand for education and skills. For example, an input-output model for the Philippines was used to assess the impact of austerity measures on its labour market (El Achkar Hilal et al., 2013).

Box 14.   Use of input-output data

The OECD regularly publishes input-output tables for a number of countries (www.oecd.org/sti/inputoutput). Where data is missing for a particular country or region, input-output tables from similar closely-related contexts can be used.

In the PERI study on the employment effects of green energy investments, the input-output tables for Ontario were not available in sufficient detail. The national Canadian data were therefore used as an approximation.
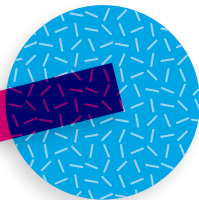
The data requirements for the input-output models are sufficiently low to be applicable in different country contexts. A study of 31 developed and developing countries across the world from 2011 showed that, with rare exceptions, data for this type of models are available, although their level of detail and periodicity differs significantly. For example, published input-output tables in the US provide detail for 420 sectors, in Thailand for 180, and in the Netherlands for 25 (ILO-PERI, 2011).

The core data needed are:

(a) input-output tables for the last available year;

(b) data on volume and structure of employment (typically from a labour force survey or eventually from an establishment survey).

The core of the model is an input-output table which shows how much each sector produces, how much of this production is used by other sectors and the amount of final demand for each sector's production. Final demand is usually distinguished by households, government, export and for capital creation and inventories; the model can translate the final demand for products of a specific sector into inputs from other sectors which support it. For example, increasing demand for cars will not only influence production in the automotive industry, but also in sectors which deliver direct inputs such as plastic and rubber, metal or electromechanical engineering, as well as indirect inputs such as chemical products or other types of material. Lower government expenditure on healthcare will also influence the demand for pharmaceutical products or catering services in hospitals.

Figure 10. National accounts data by expenditure category and by sector
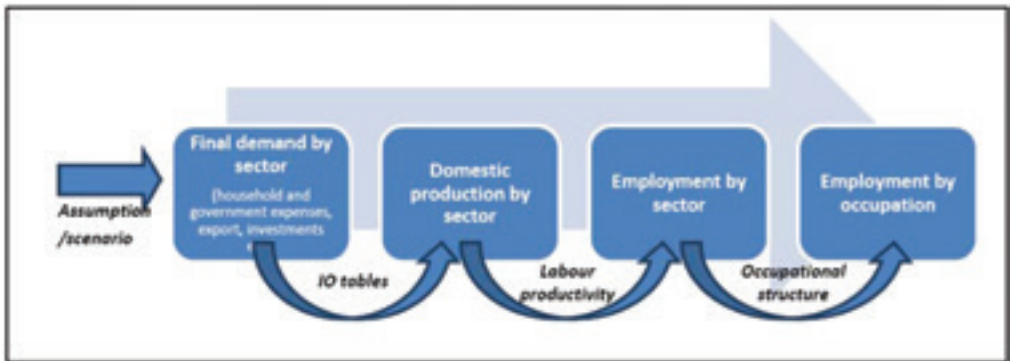
Source: Authors.
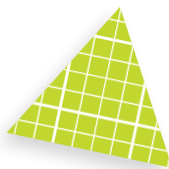
Using the information on productivity in different economic sectors, production can be translated into total demand for labour by economic sector. Further disaggregation of the employment data by occupation or other characteristics can be done if we have data on the structure of occupations in each employment category by sector. Labour force data on employment structure are usually used for this but some establishment data could provide similar information ([50]).

The model procedure can be summarised in the following steps (Meade, 2010):

(a) calculate the value of each final demand vector (demand of households, government, for products of various industries), using either econometric equations or assumed values;

(b) solve for sectoral output, using the total final demand and input-output matrix;

(c) project labour productivity in sectors using time trends or assumptions;

(d) calculate employment in sectors from production and labour productivity;

(e) project compensation per employee in sectors using equations or assumptions;

(f) determine total compensation by sector as a multiple of compensation per employee and number of employees in the sector;

(g) form macroeconomic aggregates, including totals of each final demand and value-added vector, GDP, personal disposable income, total employment and the unemployment rate;

(h) multiply sector employment by the occupation coefficient matrix to obtain total employment by occupation by sector.

Input-output models are a useful tool and are relatively transparent. However, like other models they have several limitations following from the assumptions on which they are built.

Basic input-outputs models assume that:

(a) prices are fixed and do not change with changing demand. But in the real world increasing demand for a product may raise its price;

(b) productive relationships remain stable. The same final products need the same inputs from the same sectors all the time. But change in technology may require inputs from different sectors in the future, or an international supplier can take over inputs which had been delivered by a domestic sector in recent years;

(c) there are no constraints on the supply side. Any change in demand will result in a prediction of proportional change in employment. But in conditions of rapid economic growth, in countries with a high share of the population at pre-retirement age, there may not be enough labour and/or skills to meet rising demand. Skills mismatch can cause a significant supply side constraint;

(d) everything is happening at the same time; the changes in demand influence the inputs and employment in the same period. But it is more realistic that, for example, the effect of changes in government expenditures would be sequential.

([50]) However, in developing economies coverage of establishment surveys may be limited to the formal economy.
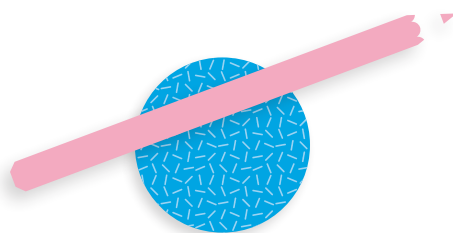
Box 15.   The Lotus model for Vietnam

The Lotus model for Vietnam was developed by Inforum (University of Maryland) in 2010 as part of the activities of an ILO project with the Ministry of Labour, Invalids and Social Affairs in Vietnam. It is a good example of the development of a quantitative employment model in a country where the labour market information and analysis has clear limitations. It shows that the development of a model can, at the same time, be an incentive for the development of an effective labour market information and analysis system linked to policy development (Sparreboom, 2013).

An inter-industry macro model is a one that builds up macroeconomic totals from industry detail, and uses the input-output solution at its core. The Lotus model currently produces a forecast for 10 years, up to 2020. It provides forecasts of input-output accounts at the level of 16 industries, the macroeconomic aggregate of final uses in current and constant prices, and provides employment projections for 21 industries comprising the Vietnam economy. Detail by type of occupation is produced for 53 occupational categories, including several aggregate categories.

Example Lotus model results: manufacturing, which is the second largest sector in terms of employment (6.6 million in 2008), is not projected to grow as fast as in the recent past. This sector is very much influenced by the growth of net exports. The projection is for both export and import growth to slow compared to 2000--07. This is due partly to a slowing in global trade as a result of the global economic crisis, but also to increases in import requirements. Increases in domestic investment stimulate a strong demand for imports, as does strong growth in household and government final consumption. The slower net export growth results in slower projected growth in manufacturing output. This factor, along with fairly strong projected productivity growth, results in an anaemic employment forecast for manufacturing. However, it should be noted that this projection is extremely sensitive to the growth of net exports, particularly the exports component, during the period 2014--20.

Employment growth rates (Vietnam Lotus model)
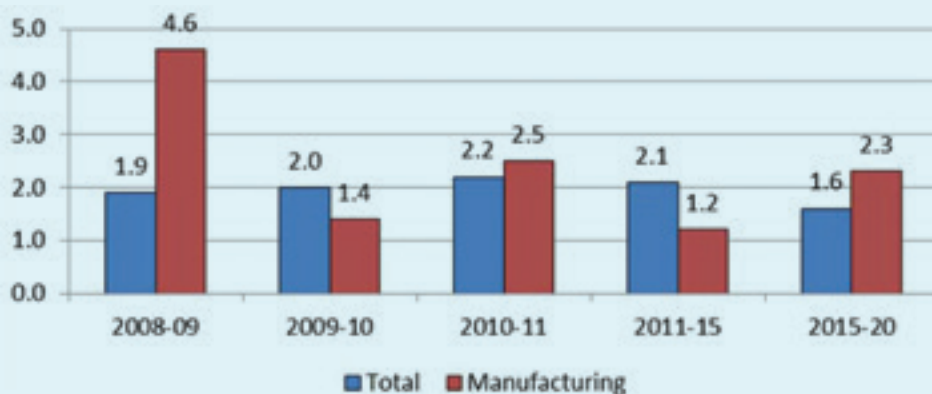
Sources: Meade (2010) and Vietnam Ministry of Labour, Invalids and Social Affairs (2011).
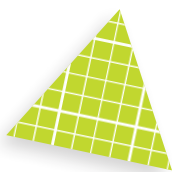
Depending on data availability, a more advanced core of input-output models can be developed to overcome these limitations and produce additional analytical outputs. For example, changes in technology over time can be modelled using input-output data from several years, while prices can be made endogenous. More detailed input-output tables allow us to develop scenarios for more specific products and sectors. Using social accounting matrices instead of input-output tables makes it possible to distinguish between different types of household or analyse the impact of taxes and government spending in more detail. The dynamic variants of input-output or social accounting matrices models allow us to consider the time dimension.

The relatively high flexibility of input-output models makes them applicable in both developing and developed countries. Additional developments of input-output models, such as price dynamics or supply side constraints, are already moving towards more sophisticated CGE models.

8.4. Qualitative inputs into quantitative forecasts and expert evaluation ([51])

Given the inherently uncertain nature of future developments, there are some doubts about the value of historic information for future forecasts. 'This time is different' is a slogan that has been used many times to indicate paradigm shifts in the economy, in labour markets or within technologies. This critical view of the extrapolative capacity of history for future developments is an important reason to think about expert evaluation in skills forecasting.

Breaks in series, missing data or insufficient coverage of the economy are very often obstacles to robust modelling in transition and developing countries. The results of quantitative forecasts can only be as good as the input data, and the development and calibration of a quantitative model takes time. Expert evaluation and qualitative approaches can be a valid and useful tool to fill these gaps, at least during the earlier stages of development of the anticipation system.

Both these reasons provide relevant justification for combining quantitative modelling with qualitative methods and expert judgements. Collopy and Armstrong (cited in Moniz, 2008) argue that the accuracy of forecasts improves if they include some judgement elements, for example:

(a) combination of judgement forecasts with extrapolation;

(b) adjustment of current status by judgement;

(c) use of judgement, not computer, to adjust outliers;

(d) adjustment of trend by judgement ([52]).

In practice, there are many approaches to combining quantitative forecasts with qualitative methods.

A frequently used option is a qualitative evaluation and interpretation of quantitative forecasting results. In the Netherlands quantitative results are discussed within a group of (external) experts from employer associations, sector councils and government agencies. This feedback is included in the deliberations about the final interpretation of the quantitative results.

In some countries qualitative methods are used to provide directs inputs into a quantitative forecast. The
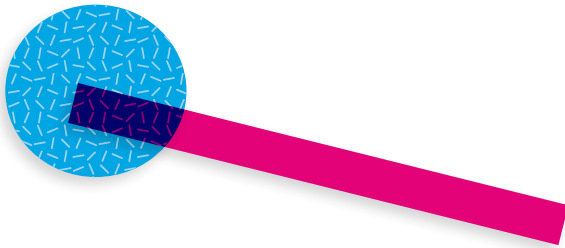
volume and form in which the qualitative aspects influence the final outcomes of the projection vary.

The E3ME model used for Cedefop European forecasts produces the initial projections, based on the estimated model parameters, historical data and assumptions about economic and population growth. Then the initial results are shared with a group of national experts who provide their feedback; they may also bring information on likely future trends which the model was not able to take into account.

The Canadian COPS model includes several entries based on qualitative judgements. In the school-leavers component of the model, analysts prepare a set of matrices which only permits employment of a graduate in a related occupation. 'The constraints are quite lenient and workers are allowed to move to any occupation within the same skill level (as defined by the level of study usually required) as well as numerous related occupations in other skill levels. The goal of the constraining process is to limit the number of post-secondary graduates who move into low-skilled occupations' (Ignaczak, 2011). Comparing this *ex ante* scenario, prepared by analysts, with the *ex post* scenario which models actual outcomes that postsecondary graduates encounter in the labour market, can support analysis of education-occupation mismatch. Other expert inputs in the COPS model are related to the vetting of projected trends in expansion demand and to the imbalances indicators. In the latter, a qualitative recent labour market condition assessment is applied to adjust the implicit assumption of the model that the occupation is balanced in the base year (Table 16).

Table 16.   Canadian COPS model: the outlook for labour market conditions by occupation is determined using observed conditions in recent years and projected trends in jobseekers and job openings

Recent labour market conditions \ Projected gap between future job openings and jobseekers	Job openings > jobseekers	Job openings = jobseekers	Job openings < jobseekers
Shortage	Shortage	Shortage	Balance
Balance	Shortage	Balance	Surplus
Surplus	Balance	Surplus	Surplus

Source: HRSDC http://www23.hrsdc.gc.ca
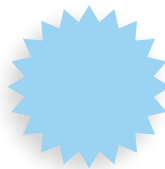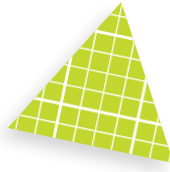
Sometimes the qualitative inputs are used to form a whole component of the forecast. There is no robust model for forecasting employment by sectors in the Czech Republic, so expert scoring of future productivity and employment in the sectors was used in combination with extrapolation to break down total employment into sectors. The weight of the expert opinion for the final projection was generally 50%; it was higher in sectors more likely to be influenced by the economic crisis ([53]) or more sensitive to political decisions.

Within the German forecasting model for the Ministry of Labour, several qualitative studies on key drivers of future economic changes form the basis of qualitative scenarios that are used to adjust and guide quantitative models (Vogler-Ludwig et al., 2013).

A final example shows the use of expert judgements as an important integral component of a highly developed quantitative forecasting system. The US Bureau of Labour Statistics (BLS) uses expert evaluations in determining expected developments in individual occupations. While sectoral and economic trends use economic (forecasting) models, experts within the BLS are responsible for a view on the development of their occupations. These are experts working at the BLS who track occupations and their development over time as well as technology and organisational trends related to these occupations. The shares of occupations in sectors are adjusted for the target projection year based on the experts' judgements.

The ultimate decision on how to combine quantitative forecasting with expert inputs depends on the country context. Data gaps, models at earlier stages of development, forecasting in rapidly changing conditions or ambition to cover new phenomena in the forecast may require more direct qualitative inputs. The availability of high-quality long time series and well developed quantitative tools allows quantitative and qualitative results to be brought together at a later stage of the anticipation process, when the recommendations are formulated.
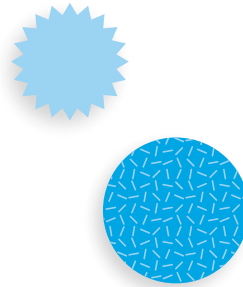
([53]) The forecast was prepared in 2009 the past employment data did not reflect the impact of the recession.

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Chapter 9.
Components of skills forecasting

9.1. Supply

Ideally, analysis and projections of the changing numbers of people holding formal qualifications should be built around a stock-flow model (Bosworth and Wilson, 2011), focusing explicitly on the inflows to the active population of individuals with different levels of qualifications. Such models allow for medium- to long-term trends in rates of acquisition of qualifications and economic activity rates, while also allowing for the outflows of individuals from the active population as they come to the end of their working lives.

In the Netherlands, supply is generated based on demographic flow models of the Ministry of Education. These flow models determine the transition probability between the different stages of the education pathway, i.e. the proportion of students that leave one form of education for another, where these movements are separated by having obtained a degree or not. These flow forecasts by the ministry are, however, differentiated only by the level and type of education, not the fields. To allow for the fields of education the Research Centre for education and the labour market, ROA, has developed a module that allocates the flow outcomes of the ministry to the final education states by level and education (for up to 110 education types).

Education choices are taken at various moments in life, influenced by, for example, economic motives, demographics, abilities and socioeconomic background. At national level, the distribution of a country's population and labour force across the various levels of qualification is also affected by the state of the economy and government policy on education expenditure.

However, such models are very demanding, requiring consistent data on stock and flows as well as information on the factors that drive behavioural choices. Development of a stock-flow model is often beyond the scope of skills forecasting projects; analyses are often restricted to a focus on the stocks of education attainment utilising simple methods [54].

At macroeconomic level, other studies have explained the importance of more general economic factors. A study by the European Commission focused on average aggregate macroeconomic trends (Livanos and Wilson, 2008). It suggests that, at this level, the main factors affecting educational attainment can be summarised by the following equation.

$$X = f(G,W,E,R,T,U,S)$$

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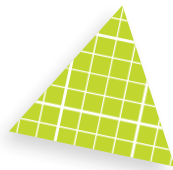
[54] In the Netherlands, the use of supply flows is included in their forecasting model. Separate analysis on flows has been conducted by ROA, and the results from the two methods compared (Cörvers et al. 2010).

Here X denotes average educational attainment, G denotes GDP growth, W denotes wages, E denotes the employment rate, R denotes returns to education, T denotes personal taxes, U denotes unemployment benefits, and S denotes education subsidies to encourage private investment in education (Livanos and Wilson, 2008). It is suggested that these factors have an impact on a country's overall levels of education. However, there is some ambiguity in specifications, such as in the direction of causality: does education lead to GDP growth or is it an outcome from it?

9.2. Employment change

The overall level of employment by industry is usually derived from a macroeconomic model that takes feedback-loops into account. Overall employment by sector can then be translated by a separate model or module into occupations using shares of employment by occupation within each industry. In a similar fashion, translation of overall employment can be translated into qualifications demanded. In both cases, this can be done in various ways, ranging from holding the shares fixed, to fitting more complex non-linear regression trend models.

Modelling employment shares can include:

(a) fixed shares;

(b) OLS logistic trend estimates;

(c) OLS linear trend estimates;

(d) OLS linear trend (moving) average estimates;

(e) multinomial logistic regressions.

Which type of econometric model is chosen to translate sector development into demand by occupation or qualification depends on several aspects; the best choice depends on the data available for that particular industry and model fit of the various specifications. Gaps in the data, and statistical noise, can result in unstable estimates. Judgement is also required for the final choice, which is often based on the evidence of qualitative analysis and other sources. This overall approach can be regarded as focusing on the demand side.

The number of people in employment by occupation is determined by multiplying employment per industry by the shares of occupations in that industry's total employment, and then summing over all industries.

The number of people in employment by qualification is determined by multiplying employment by occupation by the shares of qualifications in that occupation's total employment, and then summing over all occupations. This process delivers a consistent set of employment estimates across all three dimensions (sector, occupation, qualification).

Expansion demands for both occupation and qualification are the net change in employment from these equations, calculated between any two years. For example, total expansion demands by occupation between 2010 and 2020 can be calculated by subtracting the calculated values for 2010 from those for 2020.
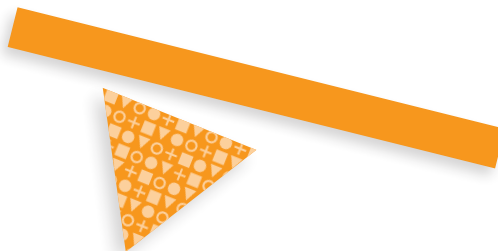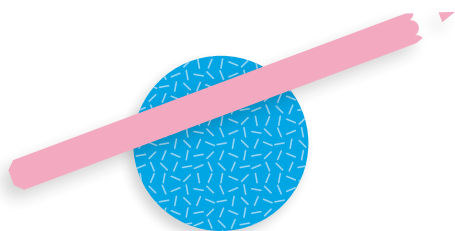
Box 16.   Examples of econometric specifications in Cedefop's expansion demand

The projections of occupation and qualification shares are conducted separately, and are based on a similar methodology, in turn similar to the supply share estimates. Various factors might explain changes in occupation and qualification structure, and estimation of complex, behavioural models is complicated in practice, mainly due to data restrictions. This report presents results based on simple models that have time as the only repressors. However, in future stages of this project a behavioural element will be included in the analysis to provide better insights into factors that affect changes in occupations and qualifications structure.

The models estimated include a range from the general form shown in equation:

$$Sijt = F(time)$$

where Sijt denotes the share S of occupation i in industry j in time t. Three main methods of analysis were adopted. These are based on analysis of occupations/qualifications shares in employment extracted from the EU-LFS data, and adopting specifications as in the equation above.

These range from simple extrapolation between fixed points, to various methods based on 'line fitting'. The latter includes fitting:

- a linear trend [S = a + b*Time];
- a log linear trend [Ln(S) = a + b*Time]; or
- a logistic equation [Ln(S/(1-S)) = a + b*Time].

For the shares to add up to 100% an ad hoc external constraint is imposed in all the above models.

9.3.   Replacement needs

Replacement demand focuses on what might be called 'permanent or semi-permanent' withdrawals from the employed workforce. These include retirement, family care or other reasons for temporarily leaving the workforce, and emigration.

Replacement demand often provides a very large share of the job openings in an economy. It easily surpasses the share of job openings based on changes in the employment structure, such as growing occupations or growing demand. Estimating replacement demand to identify job openings by qualifications or occupations can be an important part of the skills forecast.

Projections of replacement demand require three main inputs:

(a) a forecast of demographic development within a country;

(b) a forecast of (changes in) participation, preferably by gender and age groups;

(c) an estimate of the outflow by occupation/education category, gender and age group.

The outflow estimate by occupation or education, gender and age can be developed using the cohort component method, which is based on comparing the number of persons in the same age cohort at two different points in time [55].

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[55] The described methodology is based on that developed for the Netherlands (Cörvers et al., 2010) and also used for the European skill forecast (Kriechel and Cörvers, 2009; Kriechel and Sauermann, 2010). Similar models using variants of the methodology are used in several other countries, both within and outside the EU (BLS, 2008; Fox and Comerford, 2008; Shah and Burke, 2001).

From the labour force survey, it is possible to analyse the demographic composition of each occupation or education category. This makes it possible to estimate specific rates of outflows for each occupational class or education type. Projections of occupational employment typically focus on the total numbers of people who are expected to be employed in such jobs in the future. While these estimates can provide a useful indication of areas of change, highlighting the likely net 'gainers' and 'losers', they give a misleading impression of job opportunities and skill requirements. Even where the projections indicate significant employment decline over the medium term, there may nevertheless be quite good career prospects with significant numbers of new job openings. This is because, as long as significant numbers are still likely to be employed in the future, employers will need to replace those employees who leave because of retirement, career moves, mortality, or other reasons. Replacement demand may often dwarf any structural or expansion demand, resulting from growth in employment in a particular category. It can easily outweigh any negative changes from projected employment decline.

The main problem in estimating replacement demand is that official statistics place much more emphasis on measuring stocks of people in particular states, rather than flows from one state to another. Yet it is the measurement of such flows which is essential to estimating replacement demand, ideally requiring a full set of demographic accounts that traces individuals' movements from one socioeconomic position (such as employment in a particular occupation) to another (such as retirement). In practice, such a complete set of accounts is rare even at national level.

The information on outflow rates is often estimated using stocks of age cohorts within occupations for several years. Using the year-to-year changes, the outflow rates by occupation-age cohort can be estimated. However, these estimates may not allow discrimination between the reasons for the outflow that leads to replacement demand.

Data on age structure are required since many of the flows, especially retirement, mortality and occupation mobility, are age-specific. Age structures vary significantly by occupation and education type. Differences in age structure across occupations influence replacement demand due to occupation mobility and retirement, which are age-related. Even inter-occupation mobility is affected differently over occupations.

Realised retirement rates can vary by gender and by age and may differ for different occupation groups and education. Outflows at an older age are often tagged as belonging to early retirement or retirement. Within replacement demand models it is also possible to include a mandatory or statutory retirement age. The assumption is then made that all employees beyond that age will leave the occupation because of retirement.

Occupation mobility is an additional source of replacement demand in some occupations, although not for all. The full occupation mobility flow matrix indicates that some occupations, such as managers, tend to gain employment as people are promoted from other positions. The cohort component approach does not differentiate replacement demand due to occupation mobility; it only identifies net mobility.

Another potential outflow is mortality. While losses due to death are not great for individual age groups up to the age of 65, they can cumulate to produce significant losses over an extended period. The focus of the cohort component methodology is to identify overall outflows over cohorts, irrespective of the cause (sickness, death, family obligations).

The overall scale of change is dependent on the length of the period considered, as well as the opening stocks and the age structure of the current workforce. Replacement demand is also dependent on the level of occupation aggregation. With lower levels of aggregation, observed occupation mobility is lower. Mostly, projections of rates of outflow are assumed to be constant over time. The scale of structural or expansion demand (which in some cases may be negative) is usually modest compared with replacement needs; in most cases the latter offsets any negative change.
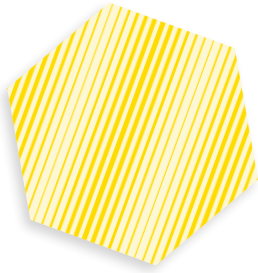
There are three components to the model:

(a) a forecast of demographic development within a country;

(b) a forecast of (changes in) participation on the labour market, by gender and age groups;

(c) an estimate of the outflow by occupation (education) category, gender and age group.

Components (a) and (b) are considered external to the replacement demand model; they are set to be consistent with the other elements of the model. Component (c) is derived using the cohort-component method described below.

The first step in modelling future replacement demand per occupation class is a description of the inflow and outflow patterns by occupation class in a historical period. The historical experience of outflow of specific (age x gender) groups within an occupation or qualification is used to predict future outflows, based on the implicit assumption that past behaviour has something to tell us about future outflow. Any type of outflow coefficient can be used; the closer this outflow coefficient is to the true behaviour of labour market participants, the better.

Because there are no appropriate data for mobility flows on the labour market, stock data are used. With the cohort components method, cohort change rates based on the number of persons of the same birth cohort who were employed at two different times can be calculated (Shryock et al., 1980). In essence, repeated cross -sections are used, comparing the outflow of workers through these methods.

The second step in modelling is to translate these coefficients of outflow-percentages into the replacement demand by occupation class. This methodology measures only the net flow to or from a class [56].

The third step is to project historically measured net replacement demand rates per age-gender group, measured by the estimated coefficient for a particular occupation class, onto the age-gender structure of workers at the beginning of the forecasting period and for each subsequent year. The model can be improved by correcting for participation rate changes, in which an increase in participation implies lower replacement demand. Higher worker participation rates manifest themselves in this model by lower outflow rates [57].

Crucial factors in the estimation of replacement demand are the age and gender distribution of workers in a specific occupation. Reliable measures of this distribution in the base year, and in the past, make the estimates more reliable.

Box 17. Simplified replacement demand: concentrating on retirement outflows

If detailed data on the age/occupation or age/qualification structure are unavailable, it is possible to approximate replacement demand by its main drivers. The biggest share of replacement demand is generated through retirement or early retirement. If the share of older workers is available by occupation (all workers above 55 years of age), assuming the outflow of these workers over the remaining period up to the legal retirement age is a workable approximation of the main share of replacement demand.
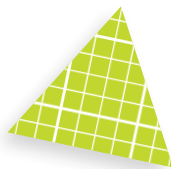
[56] This means that replacement demand satisfied by returning workers of the same age cohort is not measured, so replacement demand is actually measured for newcomers on the labour market.

[57] For a more detailed description, see: Kriechel and Sauermann, 2010; Kriechel and van Thor, 2011.

Chapter 10.
Specific issues in skills modelling

10.1. Technological change

Technological change, changing trade patterns, outsourcing and different forms of production, can lead to important shifts in a country's economic structure. This can lead to important changes in the sector, occupation and qualification structure. There is evidence of a shift from unskilled to skilled workers (Machin and van Reenen, 1998; Autor et al., 2003; Machin, 2001; Murray and Steedman, 1998), but also towards a polarisation of occupations into high skill and very low skill (Goos et al., 2009). It has been suggested that the main causes of this chahange are the use of real incomes and related changes in patterns of demand for goods and services, international trade and skill-biased technological change.

Briscoe and Wilson (2003) used annual data from successive UK labour force surveys to model occupation trends over the period 1981 to 1999. They developed time series models for some nine occupation groups across 17 industry sectors. The variables they used included output, wages, unemployment, and export and import shares, which were combined with different technology (trend) and interactive dummy terms to identify the most significant determinants of the changing demand for skills.

Cörvers and Dupuy (2006) developed a model to explain the occupation structure of industry sectors in the Netherlands. They estimated the structural parameters of a model for the period between 1988 and 2003 using system dynamics OLS techniques to account for the employment dynamics dependence across occupations and sectors of industry. Cörvers and Dupuy (2006) distinguish between 13 sectors of industry and 43 occupation groups. They argue that employment series by occupation and sector have both a long-term relationship with levels of value added, capital and R&D, reflecting the production technology specific to each sector, and a short-term relationship with changes in value added, capital and R&D. The results indicate that high-skill occupations have a negative and significant elasticity with respect to value added, but a large and significant positive elasticity with respect to R&D. Output expansion in a sector led to a decrease in employment in high-skilled occupations within that sector. However, this effect can be partly or fully compensated for by the complementarity of high-skilled workers with new technology, as indicated by the positive elasticity of employment in high-skill occupations with respect to R&D. Intermediate-skill occupations have a positive and significant elasticity with respect to capital. The results have been used to complement the expansion demand model, and to include these shifts into the allocation of sector developments to occupations.

10.2. Skills mismatch

One of the problems skill forecasting wants to address is to avoid skill mismatch, by no means a new phenomenon [58]. Overeducation – people working in a job below their education level – signals overinvestment in education which are costly to society, while undereducation – people who work in a job above their education level – signals underinvestment in human capital that could result in productivity loss. The literature discusses over- and underqualification at individual level (such as the wage and welfare effects of skill mismatches, see Hartog, 2000; Sloane, 2003; Leuven and Oosterbeek, 2011). These studies show that overqualified workers suffer from wage penalties relative to workers whose education is better matched to their jobs, whereas they earn more than others at their respective job level if they are overqualified.

[58] Richard Freeman's 1976 book *The Overeducated American* was the first to touch on the issue of individuals working in jobs below their level of education. Ever since, there has been a lively debate as to the causes and consequences of skills mismatch (and overeducation in particular), and the body of literature growing.

There is currently a tendency for people to attain higher- level qualifications in all economies. This move towards higher levels of education has the potential to result in overqualification if the skills demanded do not increase in line with supply. In general, it is expected that the increase in the number of people with higher-level qualifications grows broadly in line with the expected trend in skill demand, at least in advanced economies. Increase in the high educated workforce is essential to the development of a knowledge-based and innovative economy.

A perceptive theoretical framework is provided by Sattinger (2012), who introduces two concepts of skill mismatch: short-term qualitative skill mismatch and long-term qualitative skill mismatch. Short-term qualitative mismatch is a temporary mismatch that is the result of matching under imperfect information. Not all workers find adequate jobs for their qualifications, nor do all firms find the perfect candidate. The implied policy would be that the matching process should be organised more efficiently, either by making information more transparent or by decreasing the cost of its acquisition. Long-term qualitative mismatch is more structural; it is the result of changes in qualifications or skills demanded in jobs which are not, or only poorly, reflected in the worker's education. The policy implication would be the need to anticipate such long-term mismatches and adapt education policies to react to such shifts.

The skills mismatch and use of labour market information for better matching is the topic of Volume 1.

10.3.   Imbalances

Comparing current demand and supply projections is problematic, both practically and theoretically. Unless the two sets of results are based on common data and are carried out simultaneously, they cannot be directly compared. Various other conceptual and methodological issues regarding imbalances need to be considered with some care if misleading inferences are not to be drawn.

Initial projections of the demand for and the supply of skills are developed independently. Many adjustment mechanisms operating on the labour market reconcile imbalance and mismatches as they evolve: short-term influences include adjustments in wages and different kinds of mobility, as well as changes in the ways employers utilise available skills. In the longer term, both supply and demand adjust to imbalances and the short-term adjustments they have created. Generally, employers will not cease operating if they cannot find the ideal mix of skills but will work with what is available.

There are several techniques to identify and analyse imbalances. Koucky et al. (2010) describe the Australian and Canadian forecasting models, where supply and demand are matched, taking the differences between them as imbalances. In the Canadian model the emphasis is on the occupation side, while in Australia the emphasis is on education level and (broad) field.

The Dutch procedure is to derive imbalances after some of the discrepancies have been solved. This should mimic the market mechanism that routinely solves minor discrepancies automatically. However, the procedure does not solve all imbalances, nor is that the intention. The substitution process often carries over imbalances from an initial education type to other related education types, which aim to solve the initial imbalance (Cörvers et al., 2010).

The ultimate goal of skill forecasting is to make predictions about future imbalances in supply and demand. Understanding the main outcomes of the forecasting exercise comes from presenting key trends in a comparable way. Bringing together supply and demand, however, is also the point at which all accumulated inaccuracies might show. In an ideal world, indicators would be insensitive to the
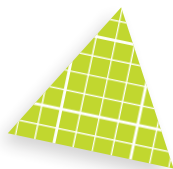
accumulated error while showing the trends clearly. The results of the imbalance indicators should be seen as indicative of the situation that would evolve if current trends in sector, occupation and education level continue to develop in the same way. Within the imbalances it is shown that discrepancies will arise that have to be solved in the labour market. It is difficult to assess *ex ante* in which way such a market process will solve the imbalances.

10.4. Indicators

Indicators supply a translation of some aspects of the forecast outcome. They provide and summarise information that comes from within the forecasting model, or that combines it with external information. A good indicator translates outcomes to ease interpretation. A typical indicator shows the demand pressure on specific occupations or qualifications that indicate imbalances which might lead to recruitment difficulties in the future. The opposite can be true, with the indicator showing, for a given qualification, an oversupply which indicates poor labour market opportunities for those achieving the qualification.

Many more possible indicators can be derived directly or indirectly. An early discussion of indicators that can be used in a quantitative forecasting framework to support the work of guidance counsellors, companies and school leavers looking for adequate training can be found in De Grip and Heijke (1988).

10.5. Regional forecasting

Skills forecasting in many cases takes place at regional rather than national level: regional forecasts can exist alone or alongside national forecasts. It is natural to operate at regional level, as most countries match supply and demand predominantly using regional supply and regional demand. Skill imbalances can then be addressed by regional actors who are often the relevant decision-makers.

Regional forecasting follows the main methodologies presented in the second part of the guide as well as qualitative elements from the first part. Some specific regional problems are addressed in this part, while we do not repeat the methodological issues already addressed for national forecasting.

Ideally, a regional forecast is based on a national model and forecast. In such top-down approaches, the results of individual regional forecasts reflect overall development in the economy. Wilson (2008) sets out the requirements for regional forecasts that are embedded in national forecasts: they take national effects into account and make full use of any regional information that might be available [59].

Regional skills forecasting will not always have access to a national skills model, or may not always be embedded in one. Many forecasts can only make use of a regional setting, in which the national part of the development has to be approximated more or less precisely.

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[59] See Kriechel et al. (2008) for a description of Dutch regional skills forecasting, and the contributions on regional forecasting in Knobel et al. (2008), especially Wilson (2008).

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Chapter 11.
Examples of skills forecasting

Many countries have anticipatory measures in place and others are building and developing systems for skills anticipation. Approaches vary, but all have a common objective: to improve the match between labour demand and supply. There is a clear shift from top-down, manpower planning towards informing all labour market participants about the knowledge and skills required, and changes in job contents, in different occupations.

There are various approaches to achieve these aims, combining different methods and the efforts of many different institutions and projects. These range from analysis of quantitative/qualitative trends in the labour market, through development of policy proposals to bridge the quantitative/qualitative gap, to fostering cooperation between firms and TVET ([60]) providers. However, implementation of policy in practice, and creating programmes/actions to bridge the gaps identified in the results, remain the most difficult points.

Many countries carry out regular skills forecasts. Most long-term forecasts are done at national level, for example in Cyprus, France, Germany, Malta, Norway and the UK. Short-term forecasts are undertaken more generally at regional or local level, often through public employment services (PES), as in Latvia, Austria, Poland and Slovenia.

Other countries are currently developing their forecasting methodologies, such as Romania and Slovakia, including national strategies for skills anticipation, as in Bulgaria, the Czech Republic, Latvia and Poland.

Many countries, including Bulgaria, Germany, Estonia, Spain, France, Italy, Cyprus, Lithuania, Luxembourg, Hungary, Poland, Slovakia and Finland, conduct employer surveys or annual labour market forecasts to inform TVET provision planning. Cyprus, Finland, France, Malta, Norway and Portugal conduct sector

skills needs studies. In many newer EU Member States, information on skill needs is collected in one-off studies or projects. Some countries, including Germany, Spain, France, Latvia, Portugal and Romania, have multilevel schemes for policy-making and research in anticipating skill needs, linking anticipatory activities at national, regional and sector levels.

Most countries acknowledge that methods to anticipate skill needs have to improve. Quantitative and qualitative anticipation methods and results are not always consistent, and regional anticipation systems also need improving. Most countries plan to develop models and improve methodologies. Norway and Sweden will broaden the tasks of existing bodies to include anticipation and identification of skills needs. Spain has already set up a national job market observatory network. Social partners also emphasise the importance of plans to establish national information systems, develop networks for skills assessment and participate in wider EU studies.

11.1.   Pan-European forecasts: Cedefop

Anticipation systems across EU Member States, although having many similarities in features and development trends, are quite different in many respects, such as in their detailed methodology and data sources used. In consequence, they do not produce comparable data at European level.

Developing pan-European anticipation systems is important for providing comparable data on future challenges across Europe. Cedefop (with the support of the European Commission) has since 2008 produced regular forecasts of skills supply and demand for the EU and each Member State up to 2020, including details by broad sector, occupation groups and education levels.
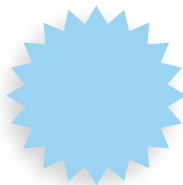
([60]) TVET is an international term used to denote vocational education and training (VET). The two terms are used interchangeably throughout this publication

To complement these quantitative forecasts, the European Commission has also published a series of studies on emerging competencies and future needs. These cover 18 economic sectors and provide a transversal analysis of the evolution of skills needs in the selected sectors, taking into account their global, national and regional contexts. The aim is to anticipate possible changes in jobs and skills needs up to 2020.

Box 18.   Imbalances in the Cedefop forecast: RAS procedure

The following contrived example aims to describe the module to reconcile supply and demand. From the initial, individual forecast of supply and demand, a net supply by education level is calculated, being the supply minus unemployment. To match supply (S) and demand (D), we reconcile them using an RAS procedure, within which, the allocation of education levels within occupations is done such that the total of all workers with an education level across occupations matches the predicted supply totals.

Consider a projection with the base year 0 and a projection into the year 5. Within that period, supply and demand are extrapolated independently. Supply is based on the population trends and the development of the education shares within different age groups, while demand is extrapolated from the sectoral forecast and the projected within sector occupation and education shifts, based on past developments.

This implies that the allocation of education levels within occupations (by sector) is a good prediction of adjustments that an occupation has experienced in the past. Based on historic evidence, we can assume that, if larger shifts in the education composition of an occupation have taken place, it will be possible to achieve such shifts in the future as well.

While the reconciliation takes place, the supply of education (levels) has to match the implied demand for education. Let us take a simple example. The contrived example depicted in the table below exemplifies the working and the interpretation of the processes within the RAS framework. In the example we assume to have three occupation and three education levels. Three occupation levels are sufficient to show all relevant relationships, but can easily be extended to any number of occupations.

Starting values within a contrived RAS example

Occ./Edu.	Demand forecast	Low education	Intermediate education	High education	Total row
Supply forecast		100	200	150	450
Occupation 1	175	75	50	50	175
Occupation 2	200	100	80	20	200
Occupation 3	75	25	25	25	75
Total column	450	200	155	95	

Source: Kriechel and Wilson (2010)
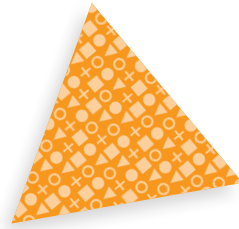
The table has several elements: it specifies the outcome of the supply forecast of education in the first row, i.e. the number of low-, intermediate-, and high-educated that will be employed. We assume that they will be employed, as the supply depicted here is net of unemployment. Then there is the outcome of the demand forecast in terms of the total number in occupations 1 to 3 in the first column. These supply and demand outcomes can be seen as fixed, providing a frame in which the underlying allocation of education within occupations has to be fitted. The last column and row sum the allocated workers within the occupation (column) and within education (row). In the example, we used the estimated demand allocation of education levels within occupations as starting values (numbers are in grey, inner matrix of the table). The interpretation is simple: these are the values that firms would demand if the current trend of development could go on undisturbed by any supply problems.

Final values within a contrived RAS example

Occ./Edu.	Demand forecast	Low education	Intermediate education	High education	Total row
Supply forecast		100	200	150	450
Occupation 1	36	75	61	78	175
Occupation 2	200	52	111	37	200
Occupation 3	75	12	28	35	75
Total column	450	200	155	95	

Source: Kriechel and Wilson (2010)

We can already interpret the discrepancies the table gives us: total demand by education is higher in lower education than the supply (200 demanded, 100 supplied), and lower in the intermediate (155 demanded, 200 supplied) and higher education (95 demanded, 150 supplied). The economy in this contrived example has thus shifted to provide more intermediate- and higher-educated candidates than required initially, while the demand for low-skilled workers cannot be met.

Within our economy we have to resolve the supply and demand discrepancies. Firms employing the various occupations would now try to fill the occupations with workers of different levels of education from what was initially demanded. In our case, intermediate- and higher-educated workers will fill the gaps that the lower-educated have left.

The RAS procedure would, at this point, reweight the inner matrix using the ratio of total demanded in education level over total supplied in education level. This scales demand by education level to match supply, but the occupation totals will – after this first (half) iteration of the RAS procedure – not match the number required. To resolve this, the matrix is reweighted again, using as weight the total of occupation in row over the total demanded in occupation. This reweights the matrix to ensure that the total demand in occupation is met. Given that this first part of the procedure will knock the total of the demanded education level somewhat away from the supplied level, we have to repeat the two steps for several iterations until the matrix converges to values where demand and supply match. The factors of the RAS procedure used to adjust the cells can be related to underlying (relative) price changes, i.e. wages that adjust to balance supply and demand.

The current policy agenda favours further developments in this area, and many EU Member States are positive about developing a common approach, or a common European tool, for anticipating skill needs. A key problem is the diversity of the current methods, tools, statistics and definitions used. But most of the countries also mention different stages of economic development as a key issue. Nevertheless, countries recognise the need for a common approach which should consider the data limitations and local knowledge. This should complement rather than substitute for activities at national level, as well as representing added value for EU Member States by pulling together existing analyses and research.
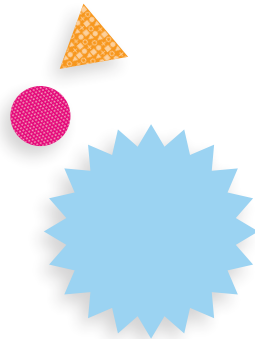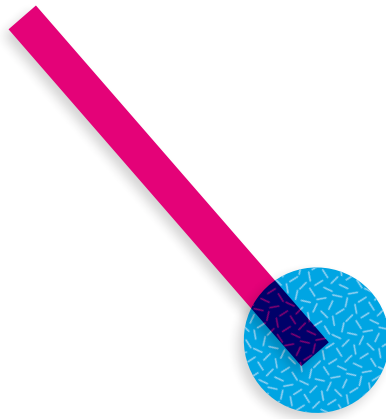
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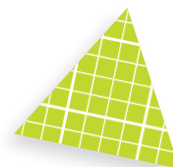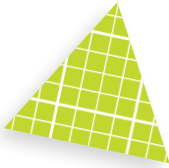
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ACRONYMS

BLS	Bureau of Labour Statistics
CBO	*classificação Brasileira de ocupações* [Brazilian classification of occupations]
CGE	computable general equilibrium
EU	European Union
GDP	gross domestic product
ILO	International Labour Organization
IFTF	Institute for the Future
IPTS	Institute for Prospective Technological Studies
ISCED	international standard classification of education
ISCO	international standard classification of occupations
JRC	Joint Research Centre
LFS	labour force survey
MCM	methods combination matrix
NACE	*Nomenclature statistique des activités économiques dans la Communauté européenne* [Statistical classification of economic activities in the European Community]
NUTS	nomenclature of territorial units for statistics
OLS	ordinary least squares
R&D	research and development
S&T	science and technology
SENAI	National Service for Industrial Training
SME	small and medium-sized enterprises
SWOT	strengths, weaknesses, opportunities and threats
TVET	technical and vocational education and training
UNIDO	United Nations Industrial Development Organisation
US	United States
USD	United States dollar

ANNEXES:
COUNTRY CASE STUDIES ON FORESIGHTS AND SCENARIOS

Introduction

The annex builds on a large range of country case studies. The review is necessarily selective, based on the following criteria:

(a) foresight processes on skills are in place in a country;

(b) available country information gives a comprehensive enough picture;

(c) the processes are able to create foresight products;

(d) the products are used by their potential users (for example, are fed into policies).

Given the diversity of socioeconomic contexts across countries it is virtually impossible to present only a few definitive examples that represent the best practices. The cases presented here provide a mix, taking into account different stages of economic development, different geographic regions and different cultural backgrounds.
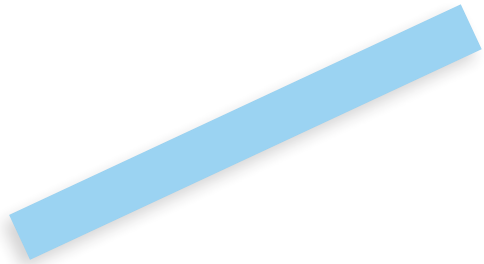
A review of the country cases reflects the fact that foresight of future skill needs is a young discipline. An ideal example of a functioning permanent system of foresight for anticipating skill needs is not available, and it is likely that no such system yet exists in any country. The most appropriate experience comes from Brazil. Other examples show some elements of skills foresights which are incorporated into an anticipation system for the future development of the society and economy, or they describe projects which could be a basis for subsequent activities in skills foresighting: Russia is an interesting example from this perspective. Nevertheless, all the cases presented bring knowledge which could be useful for those thinking about or already implementing a foresight exercise.

ANNEX 1.
Brazil

A1.1. Economic and social context

Brazil is Latin America's largest economy and the world's fifth-most populous country (200 million inhabitants). It is still classified as a developing country by the World Bank but is also seen as one of the most dynamically expanding economies and is included in the BRIC group with other important emerging economies ([61]). Although its economy extensively relies on exports of traditional agricultural and primary goods, the service sector has become the main driver of growth during the past couple of decades ([62]).

Brazil is geographically and socially heterogeneous. It is the world's fifth largest country in terms of surface area, and administratively a federation of 26 self-governed states (and one federal district), for statistical purposes gathered into five regions. Profound territorial disparities in terms of economic and social development can be found not only across these areas but also between municipal and rural areas. Despite the rapid development of high-tech sectors (nanotechnology, biotechnology, information and communications technology) the Brazilian economy still possesses many typical features of developing economies, such as economic dualism (almost a half of the 100 million workers, are part of the informal labour market), extensive poverty (one fifth of inhabitants below the poverty line), widespread functional illiteracy (one sixth of inhabitants) and pronounced economic and social inequalities often leading to violence and social unrest (highly unequal income distribution, access to public education and, healthcare) (CIA, 2013).

The nature of the dual economy and dual labour market determines the role of labour market stakeholders (employers, federal and state institutions, trade unions, sector associations). One segment of the economy is considered modern, capital and skill-intensive, with a relatively small number of mainly formal workers. Workers in the formal segment are expected to have regular, full-time jobs; they are registered, and benefit from social security, labour regulations and collective bargaining. The other, more traditional, segment is labour-intensive, comprising mostly unskilled workers; it lacks capital and has a large number of non-formal workers. Entrepreneurs and government authorities tend to organise production for profit and invest in the formal segment of the labour market. The non-formal segment, on the other hand, is subsistence-oriented, with workers or producers unable to save or invest.

In the 1990s, after years of inward-looking development strategies, Brazil decided to undertake structural reforms and open up its economy. The new development strategy has led to important structural changes in production. In the last decade the Brazilian labour market witnessed an important drop in unemployment, concentrated in the metropolitan regions and equally distributed across all social groups, although no substantial labour market reform was made during this period (de Holanda, 2011) ([63]). Similarly, employment informality has been reduced to a historical minimum (below 40%), while schooling has increased ([64]).

The recent global financial and economic crisis affected the country only mildly. In 2011 the federal government announced the *Brasil maior* plan which included tax incentives for labour-intensive sectors that are sensitive to international competition, innovation and investment measures. This plan also embraces some foresight skills-oriented initiatives ([65]).

A1.2. Main challenges and policy objectives

There is a wide range of challenges in the skills area in Brazil. The country's labour market legislation is believed by industry to have an adverse effect on employment and productivity growth. There is a need for institutional adjustments that allow companies to compete in international markets under equal conditions, while also ensuring that workers have adequate protection (Corseuil and Ramos, 2007) ([66]).

([61]) Brazil, Russia, India and China (BRIC).

([62]) Brazil has a relatively developed economic structure that contrasts with the transitional structure of employment.

([63]) Department of Statistics and Socioeconomic Studies (DIEESE). http://www.dieese.org.br

([64]) *IPEA Boletim de mercado de trabalho: conjuntura e análise* (2000-12) [IPEA Bulletin of the labour market: situation and analysis] website: http://www.ipea.gov.br/portal/index.php?option=com_alphacontent&view=alphacontent&Itemid=144

([65]) *Brasil Maior* website: http://www.brasilmaior.mdic.gov.br/

([66]) The inconsistency between labour legislation related to the 1988 Constitution on the one side, and the opening up of the economy, monetary stabilisation, the rise in the tax burden and external shocks, on the other, result in a rise in informality and higher unemployment.

The informal sector has its specific challenges in increasing the protection of workers who lack the skills to be engaged in the formal sector. Reducing illiteracy and raising the skill levels of future generations, not only by increased years of schooling but also by the quality of basic education, is seen as the way out of poverty and the informal sector for families [67]. Despite considerable efforts and remarkable social progress, increased basic illiteracy and reduced basic education quality was reported during the last decade. Education policy measures focus on addressing both quality and quantity challenges in technical and vocational education and training (TVET) in general.

Given Brazil's size, spatial mismatch is an important issue. Economic development is taking place far from traditional production regions. Multinational companies opt for transferring workers from other areas to secure skilled workers. This may further aggravate territorial disparities. However, it has been identified that newly created jobs in many states are not suitable for the most qualified workers, which underlines the skills matching issue (overqualified workers are reported to earn less than people matched to jobs) (ABDI and IPEA, 2012).

There is a need to improve the level of skills in industry. Participation in TVET and higher education is generally low in Brazil (11 % of people aged 18 to 24); promotion of TVET can be particularly challenging in rural areas and in the informal economy. There is also a general lack of teaching staff for technically oriented subjects (physics, chemistry, mathematics). Teachers' capacities need to be complemented by pedagogical competency, with a focus on the transmission of a range of high-level skills.

A shortage of talent and skilled workforce, especially those with technical qualifications, has been an issue in many industrial sectors. Activity in sectors such as oil and gas, civil engineering and the automotive industry are in urgent need of qualified labour. Companies have identified skill shortages as a key issue, and many have developed apprenticeship programmes and increased spending on training and wages. The increasing demand for new sources of energy and environmental concerns will stimulate energy efficiency and the use of renewable energies by industries, with consequent demand for qualified professionals. The same development is identified in the healthcare sector.

New technology trends exert pressure on the qualifications of the labour force, generating demand for new skills. Whether these trends can be identified and met by the Brazilian labour force without further segmentation remains the key research and policy challenge. The main approaches in the skills area in Brazil intend to address the impact of technology or production organisation on the demand for labour and its consequences for work content. Derived from this, the key questions are what professions will be needed, including emerging occupations in other countries, and what are the implications for education and training.

A1.3. Key institutions, processes, approaches, methodologies and results

Foresight in Brazil has evolved gradually. Programmes and projects incorporating concepts and techniques from a wide range of international exercises, mainly from Europe, have been launched and supported by the United Nations Industrial Development Organisation (UNIDO) or the European Commission. However, the country has also managed to develop its own way of doing foresight, often due to the creative use of limited resources, thus leading to effective innovations in practices and tools (Popper and Medina, 2008). In recent years there has been increasing use of prospective methods and techniques by Brazilian organisations (from industry, academy or government), especially to help define research priorities and strategies, as well as to foster development to support the national innovation system. These activities aim to integrate economic success, environmental quality and social equity to achieve sustainable growth, competitiveness and job creation (Santos and Fellows Filho, 2006).

[67] The successful anti-poverty scheme *Bolsa familia* (which covers one fourth of the population) offers cash conditional on school attendance and vaccination of children in targeted families.
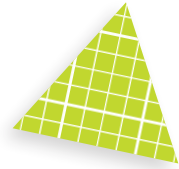
The first national foresight programme was launched in the late 1990s as Brazil 2020, a large-scale reflection on alternative paths Brazil could take in the 21st century. Four scenarios were produced, including one desired outcome for which a list of obstacles, and action to overcome them, in 17 thematic areas was identified. In the last decade dozens of foresight exercise have been conducted. The main bodies that initiated, sponsored or carried out these exercise include the Ministry of Development, Industry and Foreign Trade (MIDIC), the Centre for Strategic Studies and Management in Science, Technology and Innovation (CGEE), the Brazilian Innovation Agency (FINEP) and the Centre for Strategic Affairs of the Presidency (NAE). The areas covered include civil engineering, wood and furniture, plastics transformation, textiles and garments, energy, biotechnology, bio-fuel, agro-business, telecommunications, the petrochemical industry, water resources and climate change. Many of these studies have a human resources component; some of them even lead to occupational profiles (for example, researcher profile in 2022) (European Commission, 2009) [68]. Recent prospective studies under the national innovation initiative covering the strategic areas of nanotechnology, biotechnology and ICT within the 2008 to 2025 timeframe include methodological design leading to a proposal for six area actions including human resources (Ludovico de Almeida and Caldas de Moraes, 2010). The latest large-scale foresight activity, the Brazil 3 moments project, aims to define national objectives based on dialogue between different stakeholders in society over three horizons (2007/2015/2022). Preliminary results of the project have indicated that improving the quality of basic and primary education would have the highest positive impact on society. A specific exercise was launched on this topic (Popper and Medina, 2008).

In 2012 a brand new initiative was launched by the Brazilian Agency for Industrial Development (ABDI) and the Institute of Applied Economic Research (IPEA). The Research network: education and labour market, is aimed at drawing together a profile of the most in-demand professions in the labour market in the coming years and suggesting how to ensure TVET provision in the future. Research institutions, government and the private sector will work together to investigate the need for skilled human resources in Brazil in the short, medium and long term (ABDI and IPEA, 2012).

Institutions specifically focused on skills forecasting include labour market observatories, TVET institutions, and technical advice forums. The key objective is to identify industry needs, including by specific companies or groups. The approach is competency-based with a sectoral focus (Vargas Zúñiga, 2012). A key feature of the sectoral skills development system in Brazil is the network of non-profit institutions providing National Training Services for the industrial (SENAI), commercial (SENAC), transportation (SENAT) and rural (SENAR) sectors. While these institutions are mainly financed through a compulsory payroll tax, they are managed by industry bodies, creating a strong link between TVET and labour market needs. These institutions are based on partnerships between government organisations and stakeholders, such as employer associations, rural labour unions, cooperatives and other associations in their respective sectors. Their organisation structure is decentralised across regional administrations and states.

The best example of an integrated approach to skills anticipation in Brazil is a foresight model developed by SENAI [69]. This model develops sectoral prospects at the national (federal) level. It aims to capture industrial, technological and organisational change and the impacts on employment in order to anticipate future training and qualification needs (quantitative and qualitative). The process is managed by an executive group formed by SENAI technical representatives, academia and business representatives, who are both the producers and users of the information generated.

A continuous approach to skills anticipation in SENAI was initiated in 2001 by focusing systematically on the two main questions: how many workers by occupation and industrial sector will be demanded in the near future, and what changes to the professional profile (knowledge, skills and abilities) will be required? These two questions have been addressed by a series of interrelated activities coherently integrated in a model. Table A1 shows the original model design.

[68] Overview of foresight exercises in Brazil.

[69] SENAI is a technical and vocation education training institution focused on providing professional training and technological services for Brazilian industrial companies. It has a total of 809 TVET schools and mobile training units located in all 27 Brazilian states. In 2012 it provided professional training for 3.1 million students and workers at various qualification levels.
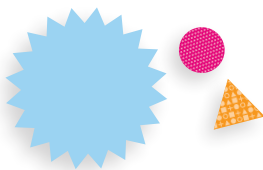
Table A1.   Original SENAI foresight model

Projects	Action	Objectives	Products
Technology observatory	Technology foresight	Conduct foresight on emerging technologies related to specific industrial sectors for a period of 5 to 10 years	Series of sector studies. List of specific emerging technologies
	Organisational foresight	Conduct foresight on new forms of work organisation for industrial sectors for the period of 10 years	List of new forms of work organisation
Occupation observatory	Analysis of emerging occupations	Identify roles and occupations that are emerging in other countries	Emerging occupations series
	Analysis of occupation trends	Identify growth rates of selected occupations in specific industries in Brazil	Series analysis of occupation trends
	Occupation issues	Conduct studies on occupation themes that impact on professional education and occupation information to generate content	Series of occupation studies. Series of occupation monographs
Education observatory	Compared vocational education	Identify changes in vocational education supply in selected countries for specific industries	Series systems of vocational education in comparison
Consolidation of impacts	Thematic antenna	Analyse occupation and education impacts in technical and technological services	Series *em tempo* (in time)
Use of results	System of occupation information (SINO)	Generate occupation information for HR managers	Industrial professions website
		Generate occupation information for the young	Almanac website
		Generate occupation information for the general public	Occupation perspectives website
		Generate occupation information for technicians and teachers of SENAI	Occupation directory website
		Generate occupation information for employed and unemployed workers	Occupation sentinel website

Source: Cruz Caruso and Bastos Tigre (2004).

The SENAI model has combined different methodological approaches under each activity (Box A1). These are foresight and forecasting approaches used to feed into occupation analysis and subsequently into thematic antenna, a workshop-like event, where the executive group discusses and analyses the outcomes, and generates recommendations for SENAI in relation to vocational training and provision of technical and technological services for the sector in focus. The recommendations generally relate to actions such as changes in curriculum design, provision of new courses, new technical and technological services and upskilling trainers. The results of the foresight exercise are released in various publications [70]. Besides providing information for industry, students and researchers, the results feed into a continuous monitoring process of occupations to support SENAI in the development of skills strategies .

Box A1.   Original SENAI model: activities and methods

The SENAI model combines several activities with their own methodology design. The main task of the technology foresight exercise is to identify technologies with greater prospects of diffusion in the Brazilian economy over five to 10 years. Sectoral studies conducted by SENAI and its partners (brainstorming, workshops and literature review are the main instruments used) are key elements of the technology foresight exercise. They characterise growth and supply/demand structure patterns, industry structure, employment evolution, investment landscape and the structure of the sector's value chain. These studies aim to elaborate a preliminary list of emerging technologies in the sector that may impact future occupation demands. The preliminary list is the basis for the Delphi rounds of expert interviewing, which is the main instrument in the foresight exercise. A minimum of 25 experts participate in two rounds of consultation. In the first, they have to evaluate each preliminary 'emerging specific technology' in terms of: its commercial viability in the country over the coming 10 years; its likelihood of diffusion in Brazilian industry and the expected timing of adoption considering all industries that are potential adopters; the impacts the technology may have on workers' skills needs (radical, incremental or low/null) and the respondents' degree of familiarity/knowledge in respect to the technology. In the second round, respondents receive the same questionnaire already processed with results from the first round (mean, median and standard deviation) so that they can reformulate their first opinion if they wish. As a result, a definitive list of technologies is produced.

Skills are influenced by adoption of new technologies but they are also a result of new trends in organisational practices. The rationale is that changes in the architecture of firms and in the way work is organised impact occupation and skills needs. This foresight exercise tries to identify management and human resources, management models, decision making structures, hierarchies of firms and contractual or outsourcing practices adopted that will impact the nature of occupations over a period of five to 10 years. The methodology is structured in the same way as the technology foresight and comprises the following steps:

(a) elaboration, by external researches, of sectoral studies revealing organisational structures present in the industry in focus;

(b) selection, by the executive group, of actors to be consulted for the prospective exercise considering the sector's value chain;

(c) preparation of the Delphi survey investigating the main organisational trends (questions explore changes in the content of work, such as the increase – or none – in the demand for more versatility from workers in a specific occupation, fragmentation or accumulation of tasks by various occupations; changes in the composition of firms' workforces in relation to contractual arrangements, for instance an increasing – or decreasing – number of temporary workers and decision-making process and hierarchy);
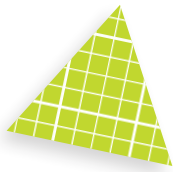
(d) application of the Delphi questionnaire in two rounds to a group of external experts;

(e) tabulation of the information; analysis and validation by the executive group; and

(f) elaboration of a list of organisational trends most likely to occur in the sector in focus over the coming 10 years.

Analysis of emerging occupations aims at identifying and characterising new occupations and changes in the traditional occupation content. Research conducted in the US, Canada, Australia, New Zealand and in the United Kingdom on sector occupations is revised and occupation content is compared to the Brazilian classification of occupations system (CBO) (literature review and comparative analysis methods are used). These countries are selected because they systematically monitor occupation changes and because their occupational classification systems are compatible with CBO. Occupations are then classified as 'emerging' if they comprise a whole new range of tasks that do not find correspondence in the existing classification system; 'in evolution or changing' when they comprise an evolving set of activities and skills; and 'stable' if they do not reveal any substantial change. This classification follows the United States Bureau of Labour Statistics definitions. Emerging and changing occupations are further characterised in terms of work and skills content.

Analysis of occupation trends applies two models to estimate future quantitative changes in manpower demand by industry and by occupation in the country. The first is an input-output model which estimates the sectoral impact on employment changes in the final demand for goods and services produced by a particular industrial sector and its value chains. The second is analysis of the database of the Ministry of Labour and Employment, the *relatório annual de informações sociais* (RAIS) [annual report of social information]. This enables researchers to identify the most dynamic occupations in a particular sector in the recent past (the ones that generated more net employment). The RAIS database offers information by occupation breakdown in five digits.

A comparative study of TVET responses aims at identifying changes in the provision of sector-specific vocational training and education services in selected countries that might guide the development of national skills response strategies. This is done through literature review. In addition to characterising the type and reach of the training institutions, financial mechanisms, and planning and organisation structures, the analysis seeks to identify which are the teaching methodologies and resources in use, how the training of trainers is being conducted and which occupations in each sector are being more or less targeted for qualification or retraining activities. Analysis also focuses on understanding the context in which the new strategies and solutions arise, so they can be better adapted to the national circumstances.

Results from the exercises are presented in the thematic antenna, a workshop-like event gathering together the executive group. During approximately half a day (four hours), outcomes are debated and analysed to generate recommendations for SENAI in relation to provision of TVET and technical and technological services for the sector in focus. The recommendations are broadly structured around the following topics: new courses provision; changes in curriculum design; provision of new technical and technological services; needs for updates and training for trainers; and needs for new studies.

Source: Cruz Caruso and Bastos Tigre (2004).
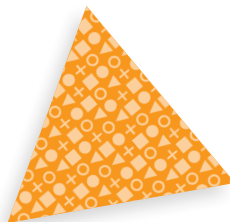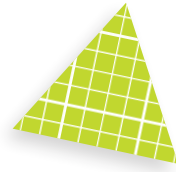
The first foresight study was prepared in 2004, based on SENAI's own model to capture industry technological and organisational change, and its impacts on the future training and qualification needs (in quantitative and qualitative terms). A scenario methodology was incorporated to increase accuracy rates, making it possible to perform analyses in contexts with variables others than those studied by the model. Scenario planning was conducted by SENAI in 2010, to provide a sound analytical basis for strategic planning to 2027 (CNI and SENAI, 2010). Four scenarios have been developed through considering possible future outcomes in different contexts: macroeconomic and political-institutional; technological; TVET; and technical and technological services. Qualitative variables were identified through expert consultation by individual structured interviews and expert panel discussions.

Table A2. 2013-27 scenario

		Brazilian context	
		Active entry to the world market through product diversification	Product specialisation with passive entry into the international market
World context	Shared leadership	Scenario A	Scenario B
	Lack of a new world order	Scenario C	Scenario D

Source: Cruz Caruso (2013).

To determine the impacts of the technology change, the technology diffusion paths and occupational impacts were identified through expert interviews. Employment projections under each scenario were prepared using quantitative modelling. These projections were disaggregated to occupation level employment projections, which were mapped to find the demand for corresponding qualifications. The final results showed the demand for low, medium and high qualified workers under each scenario.

The integration of scenarios is an example of the evolution of the model. The original version of the SENAI model has been updated and some key activities have been reorganised (technology, organisation, occupation and education exercises) to fit user needs better, but it retains its basic feature of combining coherently various quantitative and qualitative approaches to the skills anticipation (Figure A1).
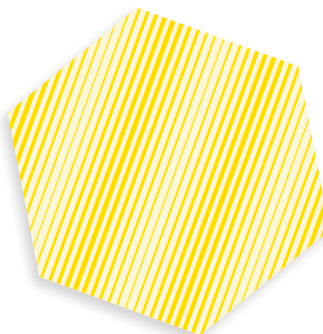
Figure A1.   Updated general outline of the SENAI model

MONITORING

SENAI vocational training scenarios
and technical and technological Services

Technological and
organizational
prospective

Occupational
impact
analysis

MONITORING

MONITORING

Sectoral vocational training scenarios and
technical and technological services

Occupational
trends analysis

SWOT
matrix

Educational
gaps analysis

THEMATIC
ANTENNA

MONITORING

Source: ILO/Cinterfor (2013).
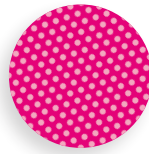
Labour market anticipation is also performed at state level by local observatories. In 2012, collaboration among observatories in the state of Paraná (observatory for prospecting and disseminating social initiatives; observatory for prospecting and disseminating technologies; observatory for industrial development) resulted in a study that analysed future skills demand through identifying promising future industry sectors and strategic routes for them, and developing professional profiles for this future (231 professional profiles in 12 economic sectors). Identification of occupation profiles for the future was based on preparatory studies on profiles, the economy and industry of the state and also on international technology, social and industrial trends. The study included university-industry interaction and methods combined expert panels with quantitative data and analysis of current professional profiles (Parise, 2012).

The occupation industrial observatory in Rio de Janeiro state is an activity of the FIRJAN system that includes the federation of industries of the state of Rio de Janeiro (FIRJAN), the industrial centre of Rio de Janeiro (CIRJ), the industry social services (SESI), SENAI and the national industrial training service and the Euvaldo Lodi institute (IEL). Its aim is to provide information on supply and demand of skilled labour in industrial sectors of the state by presenting the labour market situation, including its characteristics (distribution of formal employment across industries), trends and perspectives, and employer needs to public. The information is based on qualitative data from the systematisation of information and research from FIRJAN (such as its salary survey) and quantitative data from RAIS and CAGED (the general register of employed and unemployed). The main product is a website built according to the development map of the state: this was drafted in 2006 with the aim of promoting TVET and higher education and aligning it with the needs of the state's economic centres. The website provides regional (within the state) and sectoral views on the labour market and its perspectives ([71]).
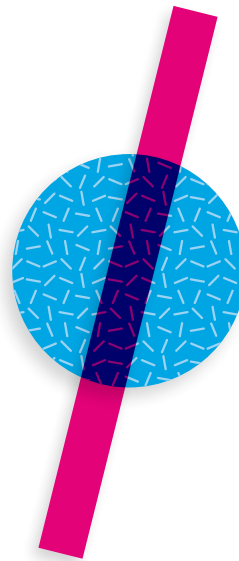
([71]) Observatorio Ocupacional – Mapa de Desenvolvimento do Estado do Rio de Janeiro http://www.firjan.org.br/site/observatorioocupacional/index.html

Figure A2. FIRJAN occupational observatory

Observatório Ocupacional | Mapa do Desenvolvimento do Estado do Rio de Janeiro

Regiões

Passe o cursor sobre o mapa para

Caracterização setorial
Distribuição geográfica
Estrutura ocupacional
Caracterização dos trabalhadores
Áreas de conhecimento relacionadas
Panorama e perspectivas

Panorama Ocupacional
Por Atividade econômica no Estado

ALIMENTOS E BEBIDAS
AUTOMOTIVA
CONSTRUÇÃO CIVIL
GRÁFICA E EDITORIAL
INDÚSTRIA CULTURAL
INDÚSTRIA ELETROELETRÔNICA
INDÚSTRIA MECÂNICA
INDÚSTRIA NAVAL
INDÚSTRIA QUÍMICA
MADEIRA E MOBILIÁRIO
METALURGIA
MODA
PETRÓLEO E GÁS NATURAL
POLÍMEROS
SERVIÇOS INDUSTRIAIS DE UTILIDADE PÚBLICA
TECNOLOGIA DA INFORMAÇÃO
TELECOMUNICAÇÕES
TRANSPORTES
TURISMO E HOSPITALIDADE

Ativid

Clique a
atividad

FIRJAN

Passe o cursor sobre o mapa para visualizar
as regiões, ou clique no panorama ocupacional por atividade
econômica no estado.

Source: FIRJAN, 2012.

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A1.4. Lessons learned

The Brazilian experience shows an expanding foresight culture reflected in the rapidly growing number of foresight products. These products result from wide adaptation of international experience to the Brazilian reality. A variety of foresight approaches, ranging from qualitative methods, such as scenario development, Delphi style methods, focus groups and expert panels, to more data-demanding formal quantitative modelling, sectoral studies combining qualitative and quantitative methods and future-oriented employer surveys, have been developed or adapted and successfully used in practice. Foresight is becoming part of strategic thinking in Brazil.

The Brazilian case demonstrates good practice in coping with the resource and capacity deficiencies found in many developing countries in areas such as institutional framework and coordination, technology and innovation promotion capabilities, inflexible scientific institutions or financing. The fact that such a large and heterogeneous country was able to develop integrated skills anticipation models, not only at the regional (state) but also at the national (federal) level, is worth noting.

The integration of sector foresight for technology, production organisation, and occupational and educational aspects under one institutional setting are further elements of good practice, helping to overcome some institutional framework deficiencies.

Networking in labour market research will help to accumulate knowledge of heterogeneous social and economic reality and develop appropriate methodologies for anticipation of future labour market trends. Networks support ambitious government projects such as building a national database of training courses to match supply and demand for TVET.

A general key factor in ensuring the success of foresight activities is the state of the Brazilian economy. Economic growth is a necessary but not sufficient condition for the success of foresight activities, directly through the financing of corresponding programmes and indirectly through influencing other context factors (for example, political and institutional stability). An unfavourable economic situation may disconnect new technologies from the main social problems and polarise the workforce. Recent social progress and increased social inclusion linked with good economic conditions (reduction of poverty, informality, inequality) directly affect the number of workers included in government-monitored activities, making foresight exercises more valuable.

ILO/Cinterfor, [72] jointly with SENAI, already promotes the transfer of the SENAI foresight model to national training institutions in Central America and the Caribbean. Five countries are involved, represented by the National Institute for Occupational Training of Costa Rica [instituto nacional de aprendizaje] (INA), the Salvadorean Vocational Training Institute [instituto Salvadoreño de formación profesional] (INSAFORP), the Institute of Technical Training and Productivity of Guatemala [instituto técnico de capacitación y productividad] (INTECAP), the National Institute of Vocational Education and Training for Human Development of Panama [instituto nacional de formación profesional y capacitación para el desarrollo humano] (INADEH) and the National Institute of Vocational Technical Education of the Dominican Republic [instituto nacional de formación técnico profesional] (INFOTEP) and in May 2012 they began the implementation of the programme Skills anticipation: the transfer of the SENAI prospective model (ILO/Cinterfor, 2013).

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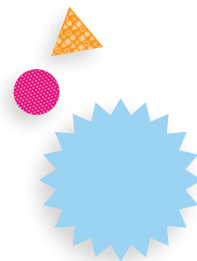
[72] Cinterfor – Inter-American Centre for Knowledge Development in Vocational Training. More information is available in 'Banco de Conocimientos de Estudios Prospectivos'.

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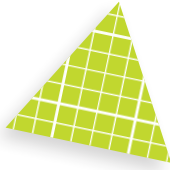
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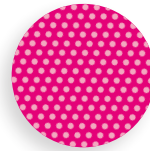
ACRONYMS

ABDI	Brazilian Agency for Industrial Development
BRIC	Brazil, Russia, India and China
CBO	classification of occupations system
CGEE	Centre for Strategic Studies and Management in Science, Technology and Innovation
CIA	Central Intelligence Agency
Cinterfor	Inter-American Centre for Knowledge Development in Vocational Training [Centro Interamericano para el Desarrollo del Conocimiento en la Formación Profesional]
DIEESE	Department of Statistics and Socioeconomic Studies
FIRJAN	Federation of Industries of the State of Rio de Janeiro
ICT	information and communications technology
ILO	International Labour Organization
IPEA	Institute of Applied Economic Research
RAIS	annual social information report
SENAI	National Service for Industrial Training [Serviço Nacional de Aprendizagem Industrial]
TVET	technical and vocational education and training
UNIDO	United Nations Industrial Development Organisation
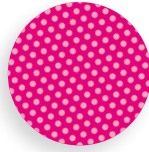
ANNEX 2.
Germany

A2.1. Introduction

A major political and economic power of Europe, Germany's economy in 2011, as measured by gross domestic product (GDP), gemerated USD 3 085 trillion. This makes it the sixth largest economy in the world (by GDP in purchasing power parity (PPP)). The service sector contributes around 70% of the total GDP, industry 29.1%, and agriculture 0.9%. Most of the country's products are in engineering, especially in automobiles, machinery, metals and chemical goods. Of the world's 500 largest stock market listed companies measured by revenue, the Fortune Global 500, 37 are headquartered in Germany. In 2010 the 10 largest companies were Volkswagen, Allianz, E.ON, Daimler, Siemens, Metro, Deutsche Telekom, Munich Re, BASF and BMW. The German economy has withstood the global economic uncertainty and the European debt crisis. The government has held firm to policies emphasising sound public finance, keeping public spending under control through deficit-cutting efforts. Earlier labour market reforms that raised working-hour flexibility and reduced structural unemployment have contributed significantly to sustaining the relatively robust job market during the economic slowdown, and that appears to be important for recovery. The official average national unemployment rate in May 2012 was 6.7%. Germany has 81.8 million inhabitants and a highly qualified labour force.

A2.2. Main challenges and policy objectives

Germany is experienced in technology foresight (as defined), which has been developed for more than 20 years [73]. Initiatives using technology foresight are targeted to the adoption of concrete political actions. This approach is mainly oriented towards technology foresight without direct focus on skills needs identification, but it provides important contributions to the further development of the high-tech strategy and innovation policy of the Federal Ministry of Education and Research (BMBF). This ministry also employs innovation and technology analysis (ITA), which studies the functioning of, and changes in, research and innovation systems, supporting courses of action but also using results for education and ministry strategy. Most of these projects are based on objectives set out in the high-tech strategy. The high-tech strategy is the first national concept to involve key stakeholders in innovation around a common idea. It was launched in 2006, and in 2010 the federal cabinet decided to continue its use. The new high-tech strategy 2020 will ensure the continuity of the overall approach and identify new priorities. Its aim is to make Germany a leader in providing scientific and technical solutions to challenges in the fields of climate/energy, health/nutrition, mobility, security and communication. Innovative technologies and services create new jobs, and so every generation will have the chance to develop its potential. Within the high-tech strategy 2020, and complementary to the activities carried out in ITA, the units of the BMBF are free to carry out their own strategic planning processes; a good example is the continuing (2013) process Biotechnology 2020+ [74].

There are several different paths, which may be used as good practice and examples of experience for other countries:

(a) BMBF foresight process;

(b) technology foresight: ITA;

(c) *Frequenz* project;

(d) skill needs forecasting approaches (without emphasis on the development of technologies);

(e) ad hoc studies (ad hoc study work in the future: structures and trends of work in industry and trade unions).

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[73] A good overview – especially on the Delphi and FUTUR approaches carried out in the 1990s and from 2001 to 2005 respectively – is provided by a case study on Germany in the UNIDO technology foresight manual (UNIDO, 2005).

[74] See also http://www.biotechnologie2020plus.de/

The foresight activities of German trade unions include some technology foresight activities. A good example is the exercise on future internet technologies and their consequences. A joint approach supported by VDI/VDE Innovation + Technik GmbH (VDI/VDE-IT), Industriegewerkschaft Metall (IGM), Vereinigte Dienstleistungsgewerkschaft (ver.di) and Deutscher Gewerkschaftsbund (DGB) elaborated integrated roadmaps for sectors and working contexts affected by future internet technologies to derive impacts on working conditions and skills needed (Botthof and Bovenschulte, 2009).

The argets of the BMBF foresight process are:

(a) identifying new research and technology focuses;

(b) identifying fields of societal changes and future demands;

(c) identifying (and defining) areas of activity covering a range of research and innovation fields;

(d) analysing potential fields of technology and innovation in which strategic partnerships might be possible;

(e) identifying priority action areas for research and development.

A2.3. Key institutions, processes, approaches, methodologies and results

The ministries mainly involved in technology research are:

(a) the Federal Ministry of Education and Research (BMBF);

(b) the Federal Ministry of Economics and Technology (BMWi).

The BMWi carries out several prognostic activities/ studies including future economic impacts of new technologies. A good example is provided by the AUTONOMIK-guideline on human-machine-interaction, addressing future challenges and needs in the implementation of advanced cyber-physical systems and Industry 4.0 technologies into production processes (BMWi, 2013) [75].

Other ministries (such as environment or traffic) are involved in fields like (electro-) mobility or energy.

Institutions involved in the BMBF ITA process

The institutions, according to research field, include: work and technology; information and communication technologies; innovation research; life sciences; mobility and urban development; nanotechnology; technology and society; environment and energy; and science ethics. By legal status they are non-university research institutes, universities, consulting companies, public research institutions, companies, networks/ organisations/associations [76].

Main technology research conductors

(a) VDI/VDE Innovation + Technik GmbH, programme managing agency for foresight and ITA on behalf of the BMBF;

(b) VDI Technologiezentrum GmbH, future technologies consulting department (VDI TZ);

(c) Karlsruhe institute of technology (KIT);

(d) Institut für Technologie und Arbeit;

(e) Fraunhofer institute for systems and innovation research (FhG ISI);

(f) Fraunhofer institute for industrial engineering (FhG IAO);

(g) The office of technology assessment at the German Bundestag (TAB).

[75] This guideline was developed in the context of the accompanying measures and investigations of the BMWi-programme AUTONOMIK.
[76] Map of innovations – Technical analysis: http://www.bmbf.de/de/5331.php

Main institutions involved in labour market research

(a) Federal institute of vocational education and training (BiBB);

(b) Institute for employment research (IAB) of the German federal employment agency (BA).

A2.3.1. BMBF foresight process

The BMBF foresight is a strategic instrument of the BMBF that provides technology foresight with a time horizon of approximately 10 to 15 years. The BMBF foresight process provides information- and knowledge-based decision-making support for long-term and farsighted action in research and innovation policy. The process is carried out cyclically and in several phases: search and analysis, transfer, and preparation of the next cycle. BMBF foresight is characterised by combining the two approaches in a cyclic process model: a cycle strongly influenced by the technology-push approach follows a cycle that is mainly demand-pull oriented, and vice versa. In this way, the results of each preceding cycle can be evaluated and further developed in the subsequent cycle from an alternative perspective. After successful completion of cycle 1 (search phase: 2007–09), the BMBF started cycle 2 with a new two-year search phase (since May 2012). The first phase was conducted by the FhG ISI and the FhG IAO on behalf of the BMBF.

For the search phase of the first cycle (2007–09), the BMBF chose a technology-orientated approach (technology push) using a set of foresight methods: literature review; scenarios; expert workshops and interviews; and international two-step panel. Young researchers were specifically consulted as inventor scouts, online surveys and other techniques. Inventor scouting aims to find people with unconventional ideas and it studies bibliometric clusters of isolated topics. The process sets out to identify people with 'unconventional' ideas in the respective area, as well as young researchers and their topics, by means of the German research association's Hochschullehrerverzeichnis (index of academic staff) (PhD students) and the young researchers' competition.

Environmental scanning (literature research and analyses of conferences and relevant results), bibliometric analyses (for dynamic developments in scientific fields), and online surveys were conducted. Central cross-cutting research fields were identified at the interfaces between individual disciplines, thus leading beyond the previous functional and programme logic (but based on the topics of the high-tech strategy and other departmental foresight activities).

The starting point for this foresight process was the 17 thematic fields (five societal demands and 12 key technologies) of the German high-tech strategy and continuous foresight activities in the departments of the BMBF. By mid-2009, a set of advanced methods of future research had been developed to identify new research and technology focus in 14 established future fields. This resulted in the so-called future topics in the areas of health research, mobility, energy, environment and sustainable development, industrial production systems, information and communications technology, life sciences and biotechnology, nanotechnology, materials, substances and their manufacturing processes, neurosciences and learning research, optical technologies, services science, systems and complexity research, and water infrastructures.

Figure A3.   Schedule of topic searches
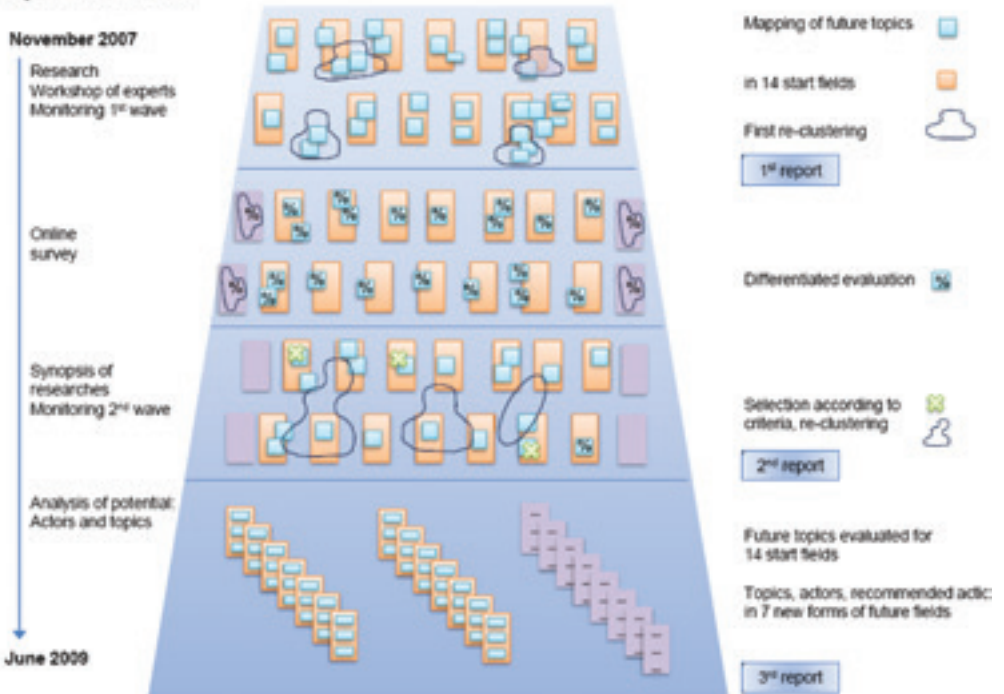
Source: Cuhls et al. (2009).
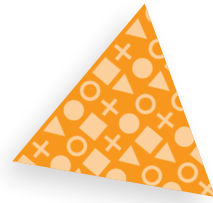
A future field is a cross-sectoral thematic field and is only defined as sustainable if it completely meets the BMBF's criteria. In this context, there are established future fields, and so-called new future fields. Two criteria were decisive in creating a new future field:

(a) research dynamics: the new field bundles a range of dynamic research aspects with a similar outlook in a way that promises to enable better exploitation of their innovation potential;

(b) needs dynamic: the new field promises to address central future challenges in an innovative way.

In Cycle 1, the combination of methods applied included monitoring, structured research, data mining, bibliometric analysis, inventor scouting, expert discourse and an international monitoring panel.

Figure A4. Combination of methods in the BMBF's process

Source: Cuhls (2008).

Cycle 2 (since 2011) is divided into three steps (which are conducted partly sequentially, partly in parallel):

(a) inventory: until spring 2013 broad trends in demand (demand pull) will be determined and evaluated. Among other areas, results from research in the social sciences and humanities will be included with developments in society and the economy, along with results from interviews with lead users and persons who exhibit a particular openness to sociocultural change. The goal, above all, is to include fringe issues – hidden trend developments and neglected phenomena – in the analysis;

(b) updating: until autumn 2013, the technology-oriented results (technology push) of foresight Cycle 1 will be updated, and previously neglected topics will be added. The perspectives of further disciplines such as the cultural, social and political sciences will be recorded and evaluated with respect to their relevance to the research policy;

(c) linking: until spring 2014 the demand- and technology-driven perspectives will be combined and linked to scenarios to point out the future areas within research and science which have the greatest solution potential.

A2.3.2. Technology foresight process: ITA

The ITA is a concept of the BMBF combining innovation research, technology assessment approaches and a middle-term foresight analysis focused on possible policy options and courses of action. ITA studies refer to the time horizon of five to 10 years (in comparison with the long-term technology foresight process). Analysis seeks to identify fields of socially accepted technological progress, illustrate potential, identify political scope, and develop options for research and innovation.

The ITA is a strategic tool to identify social innovation needs and technological innovation potential with stakeholders from industry, the academic sphere, politics and society. There is a map of stakeholders available on the BMBF website ([77]). This approach is aimed at helping different actors in the innovation process with decisions regarding research, technology and innovation. Innovation and technology analyses can contribute to identification of possible chances and risks, the acknowledgment of potential and options, and the early recognition of possible restraints and supporting factors for innovations.

The project ITA monitoring was financed within this activity to identify the most important strategic themes for ITA. It is based on problem-oriented methodology, building on TAMI ([78]) and aimed at transferring research results into practice. The project contributes to the development of strategic issues for the innovation and technology analysis, and *inter alia* for a 'topic field' call for papers (for example, of the BMBF) as well as offering opportunities, conclusions and orientations for the funding initiatives of individual departments. Short studies represent preliminary work for concrete ITA projects but they are not ITA studies themselves.

Short studies are prepared for the selected topics which comprise not only the transdisciplinary problem description but also recommendations for a problem-adequate, methodical approach. In terms of methods, short studies are only preparatory works; they contain detailed problem analysis of potential chances and risks, potential and options. Concrete recommendations for methodological proposals for the identified need of an ITA are developed from this analysis. So this project contributes to the development of strategic topics for the innovation and technology analysis (including for the ITA topic cluster tenders of the BMBF division 113) and offers possibilities for providing conclusions and orientation for the research initiatives of the various divisions of the BMBF. Systematic and continuous monitoring will be established to identify relevant ITA topics, both from technology and demand perspectives. This examines the many different institutions, instruments and strategies in industry, science and the state sector which produce knowledge and technological innovations or play a role in this process.

([77]) http://www.bmbf.de/de/5331.php
([78]) TAMI, Transparent accountable data mining initiative.

The BMBF itself is the user of the ITA project results. The entire process is coordinated in such a manner that possible topics are continuously prepared for innovation and technology analyses in three cycles. The selection of topics by relevance and priority was made in with the BMBF, taking expert opinions into account.

Following new themes, four ITAs have been identified: electric vehicles, smart grids, 'sticky information' (data handling through IT) and non-medical applications of neuroscience.

The ITA studies are larger studies based on more methods, including in-depth technological analysis. Prepared as part of the ITA was an interdisciplinary study about nanotechnology, its medical implications and economic potential. Other studies deal with issues of biotechnology and information technology.

The pilot study on nanotechnology is based on, and operates with, six thematic dimensions and four time dimensions. This preliminary study is based on secondary literature, a primary survey on ITA-related aspects in nanotechnology, and guideline-based expert talks. The experts were selected from universities as well as department heads and laboratory heads of companies. The discussions with them lasted between 1.5 and 3 hours.

(a) Thematic dimensions:
   (i)   technical dimension;
   (ii)   economic dimension;
   (iii) ecological dimension;
   (iv)   health dimension;
   (v)   individual and social dimensions;
   (vi)   political dimension.

(b) Time dimensions:
   (i)   short-term (up to five years);
   (ii)   long-term (up to 10 years);
   (iii) visionary (up to 30 years);
   (iv)   science fiction (more than 30 years) or unforeseeable feasibility.

The study includes a survey of experts. The experts were also asked about qualifications and the creation of additional study programmes such as nanostructure technology (in universities) which most of them saw as meaningful. Aside from the pilot study, two studies on nanotechnology focused in depth on its medical implications and economic potential.

A2.3.3.   *Frequenz* project

The name is an abbreviation of the phrase meaning early identification of skill needs in the network (*Früherkennung von Qualifikationserfordernissen im Netz*). The project is directly aimed at linking the topic of professional qualifications and skills needs with anticipating technological development. The main phase of the project lasted from 2004 to 2011 and the network involved 12 institutions. *Frequenz* has continuing activities such as workshops.

A2.4.   Lessons learned

Germany is very advanced in innovation and technology. National initiatives aim at developing technologies in new economic and socially interesting areas; a positive aspect is the ability to engage a network of experts and institutions in implementation of the high-tech strategy, ITA process and BMBF foresight process. This also includes the search for new scientific talents (inventor scouting) and interviewing so-called 'antennas' (persons who exhibit a particular openness to sociocultural change, see 2.3.1. BMBF foresight process, cycle 2 inventory).

Methodologies developed in Germany offer positive models in their discussion on new foresight fields; the topic searches process during the BMBF foresight process has value in this respect and the topic-specifying phase of ITA (ITA monitoring) illustrates a three-step process. Engagement of different interest groups into clusters is a good example for other countries in building up a foresight environment.

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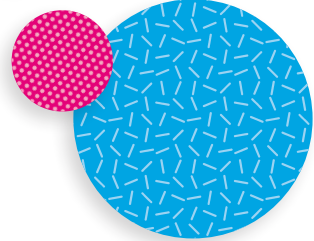
ACRONYMS

BMBF	Federal Ministry of Education and Research
BMWi	Federal Ministry of Economics and Technology
FhG IAO	Fraunhofer Institute for Industrial Engineering
FhG ISI	Fraunhofer Institute for Systems and Innovation Research
GDP	gross domestic product
ITA	innovations and technology analysis
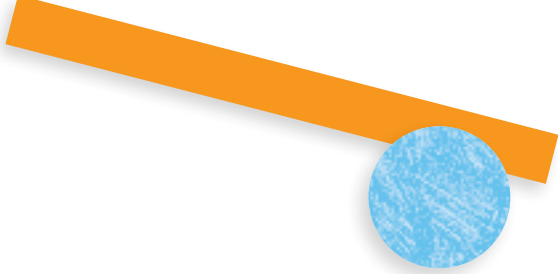
ANNEX 3.
Finland

A3.1.   Introduction and institutional context

The Republic of Finland is a Nordic country located in northern Europe. In terms of area, it is the eighth largest country in Europe and the most sparsely populated country in the European Union. Around 5.4 million people reside in Finland, with the majority concentrated in the southern part of country. The labour force is about 2.7 million people.

Finland was a relative latecomer to industrialisation, remaining a largely agrarian country until the 1950s. Thereafter, economic development was rapid, such that today, Finland has a highly industrialised mixed economy with a per capita output equal to that of other European economies such as Belgium, France, Germany and the UK. The largest sector of the economy by employment is services at about 73% of the labour force, followed by industry and construction at approximately 23%. Agriculture and forestry employ about 4% of the working population. The key economic sector with respect to foreign trade is manufacturing. The largest industries are electronics, machinery, vehicles and other engineered metal products, forestry and chemicals.

In the 21st century, the key features of Finland's modern welfare state are a high standard of education, equality promotion, and a national social security system, the last of these is currently challenged by an aging population and the fluctuations of an export-driven economy.

Finnish society strongly favours education and the population is highly educated by international standards. Education is appreciated and there is a broad political consensus on education policy. Education is compulsory between the ages of 7 and 16. Basic education encompasses nine years. Schools do not select their students but every student can go to the school of his or her own school district. Public authorities must secure equal opportunities for every resident in Finland to access education after compulsory schooling and to develop their potential, irrespective of their financial standing. Legislation provides for compulsory education and the right to free pre-primary and basic education. Most other qualifying education is also free of charge for students, including postgraduate education at universities.

General upper secondary education continues the teaching and education tasks of basic education to students aged about 16 to 19. The general upper secondary school ends in the matriculation examination which determines eligibility for all higher education studies. Students in vocational upper secondary education and training are mainly aged 16 to 25 years. The school-based education system means full-time studies for three years at a vocational institution. A total of 73% of 25 to 64 year-olds have, at minimum, gained a certificate at upper secondary level and 33% (the highest in the European Union) have had a university or corresponding education. The aim is that 92.5% of the age group 25 to 34 will, by 2015, pass an examination at upper secondary or tertiary level.

The system of vocational education and training consists of the national core curricula, each education provider's locally approved curricula and the students' personal study plans. The national core curricula are drawn up by the Finnish National Board of Education in cooperation with employers' organisations, trade unions, the trade education union, and student unions. They are overseen by training committees, which are tripartite bodies established for each occupation field by the Ministry of Education and Culture.
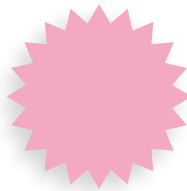
Interaction and partnerships are built at all levels of activity. There is cooperation on the development of education between various levels of administration, between schools, and between other social actors and schools. Education authorities cooperate with teachers' organisations, pedagogical subject associations and school leadership organisations. This provides strong support for development.

A3.2.   Main challenges and policy objectives

The Finnish economy has been acknowledged for its exceptionally high investment in research and development, high-quality education, and social consensus. Recent decades have, however, brought several challenges that Finland has to tackle: recovering from the 2009 recession and unfavourable demographic development connected with expected major labour supply reduction are considered as the most important. The need to deal with the expected consequences of the reduced workforce has highlighted efforts to make the education system work more efficiently to ensure that the competencies of the workforce and the needs of employers will match. As a consequence, Finnish foresight activities aim to anticipate the demand for labour, changes in qualifications and competencies of the labour force, and education needs.

The main policy goals are to improve the match between the competencies of the labour force entering the market and the skills needed by employers, improve the availability of a competent workforce, make the education system more efficient, and target education characteristics such as flexibility, transition between different levels of education and acceleration of completion times.

A3.3.   Key institutions, processes, approaches, methodologies and results

Foresight activities at both national and regional level in Finland are fragmented among many actors in both private and public sectors. There are many forms of foresight research: government level foresight; parliament level foresight; economy, industrial and skill needs forecasting carried out by public research institutes and funds; technology foresights; foresights at regional level; and foresight activities by private companies and corporations.

The focus of the anticipating activities at national level is set by the government foresight report produced once per government term [79]. The report is created in cooperation with government sector authorities and research community experts. The futures committee in the Finnish parliament deliberates the government report, proposes amendments and prepares reports concerning future policy-making challenges for the Finnish parliament. Along with foresighting projects carried out by single ministries, there is the national foresight network of ministries acting as a central government body that serves as project coordinator and as a platform for sharing knowledge among ministries.

Among the individual ministries' foresight projects are the activity of the Ministry of Education and Culture (MEC), mainly the department for education and science policy and its subordinate agency, the Finnish National Board of education (FNBE), and the Ministry of Labour. However, the cooperation of many actors is common in foresighting processes. Universities, social partners, think tanks and public sector agencies are

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[79] A new government foresight report is under preparation. The final futures analysis report, forming part of the preparations for the government foresight report, was presented on 14 February 2013. The report highlights ways in which Finland can succeed in 2030. During spring 2013, the government will prepare a foresight report for parliament. In April 2012, the ministerial working group for the government foresight report discussed the selection of foresight themes and approved the following: the opportunities in the midst of scarcity; a new geography for the north; business regeneration; public administration as an enabler; working life in the future; and citizens' well-being and inclusion. The group also discussed four cross-cutting themes: flexibility and crisis resilience; competencies and capabilities; ICT as an enabler; and the global perspective. The futures analysis phase was implemented in collaboration between the Prime Minister's Office, the Finnish funding agency for technology and innovation and the academy of Finland and Tekes, with many independent specialists and experts from research institutions, enterprises and non-governmental organisations taking part in the work. Discussions were held at www.2030.fi and at seven locations in Finland in the autumn of 2012.
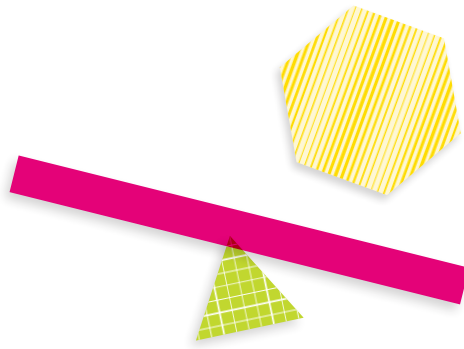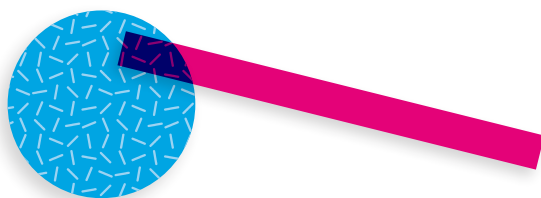
Box A2.   Adequate institutional framework in place

The Finnish foresight system has the following six parts (http://www.2030.fi/en/what-is-a-foresight-report):

- the government foresight report. This is a major report that discusses the development aspects of the country in one large thematic area, usually 20 to 30 years ahead, and defines the government's vision and guidelines. The Prime Minister's office's policy analysis unit is responsible for its preparation. Appropriate background reports are commissioned, and they are elaborated by the state's sector research institutes, such as the government institute for economic research (VATT), the national institute for health and welfare (THL), the technical research centre of Finland (VTT) and Statistics Finland. The next government foresight report is always on a new theme. This long-term visionary document is sent to the Parliament for comments. Next the Parliament futures committee with the Prime Minister's office begin discussions with citizens around the country; they introduce the report results and gather citizens' opinions. Implementation of government foresight normally takes a much longer time than one government term, which means that it partly binds the work of the next government;

- the government foresight network of people who do, order, or coordinate anticipation work in different ministries. The network has two members from each of Finland's 12 ministries. It shares produced foresight knowledge and discusses substance, issues and foresight methods;

- the Finnish parliament's committee for the future. This was established as a temporary committee in 1993 and became permanent in 2000. It collects the parliament's answer to the government foresight report, performs future-oriented duties, conducts research associated with futures studies, and makes assessments of technological developments and the effects of technology on society;

- the foresight consortium for labour force, competency, and educational needs. This was established in 2008 based on a decision of the minister's group of Finnish work, entrepreneurship and labour markets. The idea was to establish a mutual foresight system for coordinating all of the Finnish government actors' decision-making regarding vocational education and labour markets competency needs issues. The steering of the system's work is divided between the Ministry of Employment and the Economy (MEE) and the Ministry of Education and Culture (ME). The domain of the MEE contains both the short-term foresight of competency and education needs, and the labour force needs foresight, in general. The ME sets out the foresight of competency and education needs in the medium and long term. The foresight system orders its basic forecasts and input data of the labour markets and economy from the VATT. These data are further broken down for use at regional level in different administrative fields, and are also used in the work of the Government foresight network and in the government's future report writing. VATT forecasts are then complemented with other organisations' development forecasts, with corporate organisations participating in the foresight especially in fields facing remarkable structural changes. The biggest challenge here is to merge the quantitative forecasts and qualitative foresight into one storyline;

Source: Kuosa (2011).

important players in this area. The VATT prepared scenarios in 2010–11 for employment trends in different industries to 2025. The FNBE produces data on demand for labour by occupation groups and education needs. Responsibility for qualitative anticipation of education content rests with the FNBE, higher education institutions and education providers. The system of national education and training committees functions as the expert organisation in qualitative foresight of education, consisting of a steering group, the national education and training committees, and fixed-term expert groups. The system of national education and training committees is an expert organisation in qualitative foresight of education. The government foresight network is an inter-ministerial forum for cooperation and exchange of information on issues relating to the anticipation of the future.

In general, the recent foresight studies carried out in Finland concerned:

(a) education and labour market;

(b) challenges for the economy;

(c) technology and innovations.

The main processes, instruments, methods and results are developed below.

A3.3.1. Education and labour market
A.3.3.1.1. *The Mitenna model*

The Mitenna is a quantitative model developed for the anticipation of education needs; its outputs are used as a basis for formulating Finnish education policy. It is a model for forecasting the requirements for student places in comprehensive and vocational schools and universities. A broad spectrum of data sources and approaches is taken into consideration in formulating education needs forecasts. The model is geared towards anticipating long-term education needs (about 15 years) based on the requirements of the labour market, which have been used specifically in preparing the Ministry of Education and Culture's development plans for education and research, drawn up for every government term. The outputs of the model are used both directly in planning intakes into education and training, and indirectly in providing advice and guidance
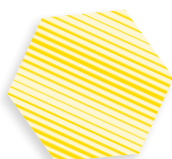
to individuals (especially young people) who are choosing their education paths.

A.3.3.1.2. *Oivallus*

Oivallus is coordinated by the Confederation of Finnish Industries (EK) and funded by the FNBE, the European Social Fund (ESF) (2008--11) ([80]) and the confederation of Finnish industries. Its purpose is to identify potentially successful fields and obtain information from a multitude of perspectives. Oivallus attempts to characterise working life in the 2020s and consider what kind of experts and skills will then be needed.

A.3.3.1.3. *The national qualitative anticipation project*

The aim of the project is to develop and establish a permanent operating model to anticipate skills needs in different sectors of the world of work. It was launched in 2008. The anticipation results will be used in the development of curricula, qualifications and qualifications frameworks. The model of anticipation developed within the project will serve different education structures and meet the anticipation needs of both national language groups (Finnish and Swedish).

A.3.3.1.4. *The education intelligence foresight system*

The education intelligence foresight system, developed by the confederation of Finnish industries, is a series of studies that seeks to anticipate changes in the industrial environment. Its outputs consist of cluster-related predictions. A cluster is understood as a network of suppliers, producers, customers and competitors related by cooperation and competition. The clusters analysed were ICT, well-being, chemistry and biotechnology, forestry, construction, real estate

and infrastructure, and service and knowledge-intensive products (SKIP).

A3.3.2. Economic foresights
A.3.3.2.1. *Economic five-year regional forecasting system by research institute of the Finnish economy (ETLA)*

Forecasting by ETLA consists of five-year predictions of the economic development of Finnish regions and industries. Forecasting outputs are summed up twice a year in the publication *Suhdanne* and include predictions of production, employment and other crucial economic indicators. Forecasts of development in Finland are linked with trends in the global economy and the situation in the European Union.

A.3.3.2.2. *VATTAGE*

VATTAGE is a model of the VATT based on an applied general equilibrium method. It is a quantitative approach to long-term forecasting of the economy and labour market.

A3.3.3. Technology and innovations
A.3.3.3.1. *Finnsight 2015*

Finnsight 2015 is a joint project of the academy of Finland and the Finnish funding agency for technology and innovation (Tekes) carried out in 2005--06 that explored drivers of change as they affected Finnish business and industry and society at large, and which identified emerging challenges for innovation and research. It also analysed focus areas of competency in science, technology, business and industry as well as society at large, that needed to be strengthened with a view to enhancing well-being in society and boosting the competitiveness of Finnish business and industry. Findings from Finnsight 2015 are being incorporated into national science and technology policies.

([80]) Oivallus final report. http://ek.multiedition.fi/oivallus/fi/liitetiedostot/arkisto/Oivallus-Final-Report.pdf

A.3.3.3.2. *Tekes foresight systems*

Tekes is the main public funding agency for applied and industrial research and development (R&D) in Finland. Tekes's mission is to fund private and public research and development projects, promote development in specific sectors of technology and industry and coordinate key players in Finnish R&D. Tekes also carries out technology foresight studies to initiate new programmes and develop a common vision and industrial strategy. Technology foresight studies typically include interviews, workshops and broad discussions, as well as having internet-aided sections.

A.3.3.3.3. *Finnish innovation fund (SITRA) foresight systems*

SITRA is an independent public fund promoting the welfare of Finnish society. It produces a multistrand foresight report: welfare and everyday living; working life; public sector; multiculturalism; and environmental technology. The foresighting programmes are done using a wide range of methods including studies, strategy processes and innovative experiments.

There are also projects carried out regularly at governmental level (the government foresight report, the ministries' future reviews) and reports from the Finnish Parliament's committee for the future that are not focused on a single topic but deal with various future-related issues.

A3.4. Lessons learned

Finnish forecasting activities seem complex and sophisticated. There are many public and private institutions involved in programmes that anticipate development in various spheres of society. Not to be surprised by future development is a subject of great importance in Finnish policy-making. Foresight research is fully embedded in the operation of the Finnish government and legislative bodies, making the level of institutionalisation unique.

The most common foresight methods are expert panels, literature review, scenarios, futures workshops, SWOT and Delphi.

What can be considered as remarkable is the way the outputs of foresights are directly transferred into policy-making. The connection between the outcomes of the anticipation of demand for labour and education needs made by the Finnish National Board of Education and the major educational policy document, the development plan for education and research, is a clear example.

Article No 103 of the development plan for education and research 2011–16 states that:

'The supply of higher education institutions in 2016 will be quantified based on national foresights:

(a) the overall volume of university education will be kept unchanged. In terms of field of education, the need for increases exists especially in teacher education. The field-specific increases will be made through the retargeting of existing provision;

(b) the intakes in polytechnics will be reduced by 2 200 entrants in 2013. The cuts will be primarily made in the fields of culture, tourism, catering and domestic services, and technology, communication and transport. A small increase is needed in health care and social services.'

Part of the development plan for education and research sets specific targets for intakes of students and expected output of graduates in individual disciplines and degrees.

Long-term anticipation data are used in preparing target and performance agreements between the Ministry of Education and the universities and polytechnics. Regular negotiations between the Ministry of Education and higher education providers are the main element of the steering process of higher education. The result of these negotiations is an agreement on the objectives, profiles and priorities, as well as quantitative targets, for single universities and polytechnics.

The intention of all stakeholders is to increase the impact of anticipation on education and training. Cooperation between ministries and different levels of administration is being promoted.

Figure A5.   Target scenarios
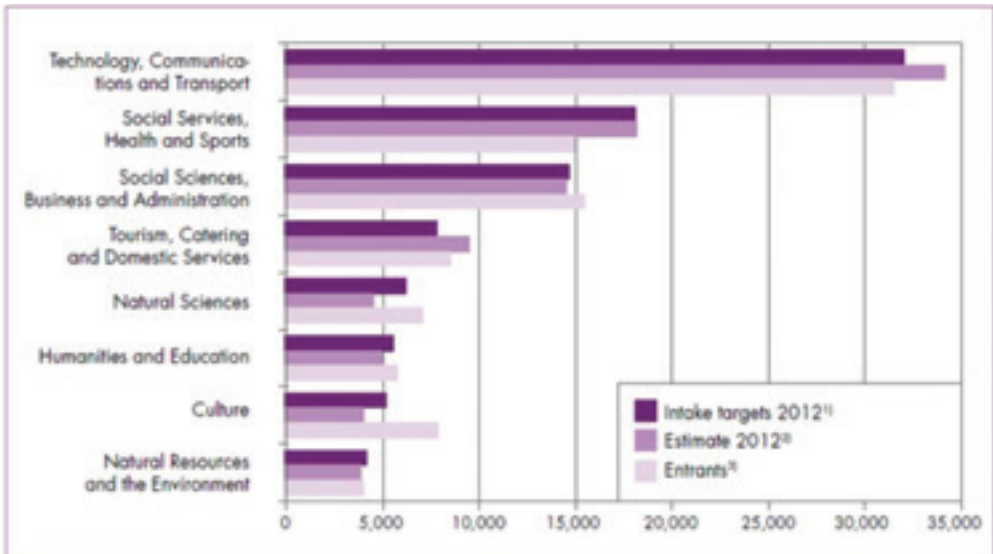
Notes:
1. Education and Research 2007–2012. Development Plan. Ministry of Education, 5th Dec. 2007.
2. Anticipation results on provision targets for 2012. Target scenario. Finnish National Board of Education.
3. New students in 2006 (Statistics Finland, AMKOTA database).

Source: Hanhijoki et al. (2009).
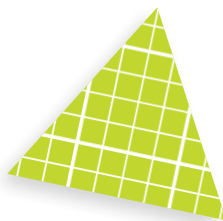
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Ministry of Education and Culture, Finland. http://www.minedu.fi/OPM/?lang=en

What is a foresight report. http://www.2030.fi/en/what-is-a-foresight-report

ACRONYMS

ETLA	Research Institute of the Finnish Economy
FNBE	Finnish National Board of Education
MEC	Ministry of Education and Culture
MEE	Ministry of Employment and the Economy
R&D	research and development
SITRA	Finnish Innovation Fund
Tekes	Finnish Funding Agency for Innovation
VATT	Government Institute for Economic Research
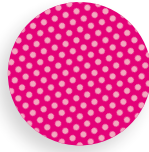
ANNEX 4.
Japan

A4.1.   Economic and social context

Japan has built its economic success predominantly on a skilled population, government-industry cooperation and intensive science and technology development, mainly within technology-based industries. It has a culture of workers staying for a long time, if not for life, with one employer, which can result in a relatively less dynamic labour market and education system[81]. Though this can mean fewer opportunities to influence the labour force directly from a central level, individual companies are motivated to invest in the development of their workforces and draw benefits from various foresight exercises.

A4.2.   Main challenges and policy objectives

The main objectives of the nationwide science and technology foresight exercises include:

(a) outlining the future prospect for evolution in major areas of science and technology;

(b) determining what should be done from now to attain future goals and overcome major global and national challenges;

(c) contributing to the development of science and technology policies (for example, the basic plan for science and technology) and to setting the corresponding priorities for investment and resource allocation;

(d) providing data to a broad variety of stakeholders and decision-makers.

A4.3.   Key institutions, processes, approaches, methodologies and results

The major technology and science foresight surveys are carried out regularly every five years and cover the following 20 to 30 years. Initially they consisted solely of extensive Delphi surveys, determining science and technology supply, but in the last two surveys (eighth science and technology (S&T) foresight in 2003–04 and ninth S&T foresight in 2008–10) the approach was broadened to cover demand for new technologies and multiple methodologies (for example, scenario development or regional workshops) were used. The results have been used by stakeholders from both public and private sectors and, since the eighth S&T foresight, also provided direct input into science and technology policy formulation (the science and technology basic plan).

As well as extensive long-term surveys, a variety of other foresight activities are undertaken. These range from sectoral foresights and mezzo-level exercises for specific industrial associations, to micro-level foresight within individual companies, using a wide range of methods.

The following description concerns the major nation-wide exercise of recent years, the ninth S&T foresight carried out in 2009. The main institution involved in carrying out the surveys was the National Institute of Science and Technology Policy (NISTEP). Associated partners included the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and the Council for Science and Technology Policy (CSTP).

The following processes and methodologies were employed.

A4.3.1.   Setting of 'grand challenges'

A preliminary discussion considered current global and national trends and identified the main scientific and technological challenges/goals for future development. The following four directions (grand challenges) were determined:

(a) central players in the scientific and technological arena;

(b) sustainable growth through green innovation;

(c) a successful model for a society ageing healthily;

(d) secure life.

A4.3.2.   Delphi survey

Four preliminary panels were organised, defined by broad themes: security, safety, international collaboration and international competitiveness. Experts (from humanities and social sciences as well as natural sciences) discussed future targets that can be attained with the contribution of science and technology, and the main global and national challenges. Through these extensive discussions, 24 'critical issues' were identified.

A total of 12 interdisciplinary panels were established (in contrast to the previous surveys where panels were field-based) to determine relevant future issues irrespective of the existing scientific disciplines. The panels consisted of 135 experts (in total) in the humanities, social sciences and natural sciences (from universities, industrial sectors and research organisations). The main topics and areas (the area represented a group of interrelated topics) for the survey emerged from their discussions.

Two rounds of an extensive questionnaire survey were conducted among experts. They gave responses on the perspectives of the topics (832 in total) over 30 years until 2040. In the end, 2 900 responses were gathered. Analysis of the final results of the questionnaire survey was then carried out.

A4.3.3.   Scenario writing

In the framework of extensive interdisciplinary discussions by expert groups scenarios, were created to outline future changes that may be brought about by the development of science and technology, including a path for reaching goals. A description of related elements was also requested, including human resource development.

Scenarios were also developed from a Delphi survey, reflecting the general consensus of the experts. Future scenes of daily life in 2025 were described, integrating forecast Delphi topics.

Group discussions were held among representatives of the younger generation to compensate for the possible age bias, as the experienced experts who took part in scenario groups or Delphi questionnaires came disproportionately from the middle-aged and older generations.

A4.3.4.   Regional workshops

Workshops were held in eight Japanese regions. Participants discussed ideal future regional lives and what kind of science and technology can be expected to contribute to them.
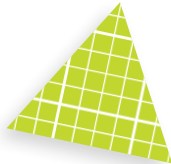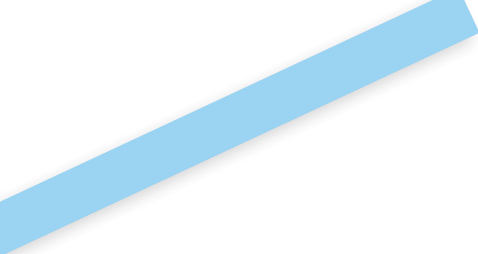
A vision of attainable an future society was outlined. Those of the Delphi topics likely to be widely available and/or widely known in society by 2025 were selected to outline the shapes of future society. The science and technology areas of key importance for attaining the goals and resolving the challenges were identified. Management of technology-related issues, such as knowledge base, business, risk, globalisation and human resources, was seen as inevitable.

A4.4.   Lessons learned

Often it is stressed that in Japanese foresight culture the main value of the foresight is seen not only in the direct outputs like subsequent policies, but in the benefits arising from the process itself, expressed as the 'five Cs': communication, concentration on the longer term, coordination, consensus and commitment (UNIDO, 2005a). From this it can be suggested that education policies have been indirectly formed by such exercises, even if no direct regular linkage has been established so far, especially since the eighth S&T foresight when the MEXT and the government CSTP were largely involved. Ministerial proposals regarding education or training are generally made by reference to surveys and estimations based on predicted change in industry structure; some may also result in policy formulation. For example, the eighth Delphi study contributed to the strategy Innovation 25 which outlines major Japanese prospects and challenges regarding innovations until 2025. It also contains a chapter on human resources where basic directions (for example, fostering the creativity of young people by gaining experience overseas) are set.

The mission-oriented and interdisciplinary approach of the ninth S&T foresight proved effective in determining the direction of innovation and its promotion strategy. Systems thinking that includes not just technical systems but also social systems and provision of services is essential for embedding technologies in real society. The survey results included a strong call to support future human resources related to the identified areas. As the responsible national bodies participated from the beginning in the survey (see 'key

institutions'), the identified needs make their way into the national policies indirectly through the major policy papers which draw on them. The S&T forecasts have been used to create a draft of the government's science and technology basic plan. The realisation time forecast in the surveys led to the setting of R&D targets in government and industry research institutes and universities. The survey results are also being considered in the process of developing the R&D plans in educational and other organisations.

Employers – especially those active in research and development – make use of the results of the foresights, and it can be assumed that many consult the results when devising their human resources strategy, though an exact overview of the methods they use is not available.

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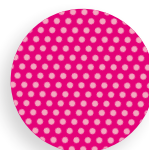
ACRONYMS

CSTP	Council for Science and Technology Policy
MEXT	Ministry of Education, Culture, Sports, Science and Technology
NISTEP	National Institute of Science and Technology Policy
R&D	research and development

A5.1. Economic and social context

The Republic of Korea has a distinctive education system that produces outstandingly well educated people in comparison with international standards, and this is believed to be one of the important factors behind Korea's rapid economic rise in the last decades. Education is egalitarian and highly appreciated. Nevertheless, the recent focus on rapidly-changing knowledge-based societies has brought new demands, and the drawbacks of the Korean education system, such as the lack of flexibility and autonomy in education institutions and insufficient diversity and creativity, have become more apparent. There are significant disproportions between labour market needs and workforce supply. The systems of the labour market (employers) and education are not sufficiently interlinked. The government seeks to address these problems by various initiatives, including merging the Ministry of Education with the Ministry of Science and Technology, the establishment of sector skill councils that identify and monitor skill needs in high-growth and technology-intensive sectors, and surveys of the demand for training in the labour market. The practical effect of these measures so far seems limited.

A5.2. Main challenges and policy objectives

The main objectives of the recent nationwide science and technology foresight exercise include:

(a) providing a vision and direction for emerging science and technology areas;

(b) identifying technologies that have a high potential of contributing to growth (in terms of national wealth as well as quality of life);

(c) implementation of the results in science and technology (S&T) policy (concretely, as in the national S&T basic plan).

A5.3. Key institutions, processes, approaches, methodologies and results

Since the 1990s, Korea has had a national foresight programme which has assisted the government in exploring the future of science and technology. It is embedded in legislation (S&T basic law) and is undertaken every five years by the Korean Institute for S&T Evaluation and Planning (KISTEP). Initially, only the Delphi method was used, but since the third national technology foresight (2003–04) a multi-methodology approach has been taken. The revision of the third national technology foresight (2007) and the fourth national technology foresight (2010–11) were directly used to feed into the national S&T basic plans that outline the S&T policy.

Following the Japanese example, Korea has developed its own foresight culture, with each of the ministries having started its own foresight projects. This background, together with the participation of the ministry responsible for education in the national foresight, sets the basic conditions for interlinking the areas of technology foresight and education policy, though concrete mechanisms are yet to be formalised.

The following description is of the third national technology foresight of 2003–04. The two main institutions involved in the exercise are the Ministry of Science and Technology (MOST) and the KISTEP.

The following processes and methodologies were employed:

(a) a panel of experts from various disciplines was established with athe task of identifying the future prospects and needs of Korean society. The prospects and needs were distinguished according to four so-called 'actors': world, nation, society and individual: 15 main themes and 43 subthemes were explored;

(b) a separate survey of 1 000 experts and 1 000 members of the general public was conducted, followed by an additional Delphi study via an internet-based questionnaire, with more than 32 000 experts (PhD holders) addressed in the first round. Almost 17% (ca 5 400) of them replied in the first, and 61% (3 300) in the second round. The questionnaire contained 40 to 50 questions about one or two of the eight defined fields of technology;

(c) scenario panels of experts with various backgrounds were set up. They visualised likely scenarios for Korea in education, labour, health services and safety systems. Alongside the experts, a group of undergraduate students contributed to the education panel, choosing one or two future technologies that might have the biggest impact on systemic change in education. They also developed related scenarios.

Databases of technology subjects were created for policy and strategy use. Out of a total of 761 technologies, 189 were selected as priorities. The databases were also complemented by the technologies with high investment potential in other countries.

A5.4. Lessons learned

The results of the foresight were used to formulate strategic initiatives and contributed to determining the priorities and allocation of resources regarding future science and technology developments. Future development of the education system was outlined within the scenarios phase in terms of how the technologies might change it.

The third national technology foresight enjoyed unprecedented public promotion. Cartoons, science books, posters, a short movie and similar promotional materials were produced with the aim of spreading a foresight culture in Korea. The revision of the third national technology foresight that took place in 2007 contributed to the policy paper on the national S&T basic plan.

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ACRONYMS

S&T	science and technology
KISTEP	Korean Institute for Sciences and Technology Evaluation and Planning

ANNEX 6.
The European Union

A6.1. Context

The European Union has an overall strategic goal to promote more and better jobs and to offer equal opportunities for all in its social agenda. There are numerous options for supporting this goal, one of which is a foresight exercise developed with the financial support of the European Commission in the second half of last decade.

A6.2. Main challenges

The restructuring processes underway in Europe should be placed in the broader context of securing and improving the EU's competitiveness, plus redeploying the European economy towards new activities with more added value and providing new and better jobs. To be successful, this approach should be underpinned by more strategic management of human resources, encouraging a more dynamic and future-oriented interaction between labour supply and demand. Without this there is the risk that greater shortages, gaps and mismatches of skills will result in structural unemployment.

Europe aims to renew its competitiveness and increase its growth potential and productivity, while strengthening social cohesion; this places emphasis on knowledge, innovation and optimisation of human capital. Fostering growth and jobs by stepping up the transition to a knowledge-intensive society remains a core ambition.

A6.3. Methodology

A methodology developed by Professor Maria João Rodrigues over the last decade supports strategic management of human resources. Professor Rodrigues, with the financial support of the European Commission, identified and analysed foresight on emergent job profiles and their training needs in the different EU Member States and recommended a European foresight cross-sector methodology. The purpose was to prepare possible future actions to investigate new jobs for Europe, encouraging more effective interaction between innovation, skills development and jobs creation.

The methodology takes several factors into account: competitiveness, industrial evolution, innovation and globalisation. It also integrates elements such as the sectoral dimension, mechanisms to update the results, and levels of precision in job profiles. This methodology has been designed with the following possible uses in mind:

(a) to identify new sector drivers for jobs renewal (main trends in demand and supply, process, products and service innovations, organisation);

(b) to support sector innovation and employment by developing foresight instruments to analyse emerging activities, shaping factors, skill needs and job profiles;

(c) to spread new job profiles in each sector in vocational guidance, employment services and competency validation;

(d) to improve strategic sector planning in education and training;

(e) to encourage the development of partnerships for innovation, skills and jobs at sector level, involving all stakeholders.

The methodology includes the following steps:

(a) present and analyse the main economic and employment trends and the occupational structures of the sector over the past 15 years;

(b) identify the main drivers of change with regard to the sector: economic, technological, organisation;

(c) identify the main emerging or changing sector job profiles, skills and competencies;

(d) identify three different scenarios (roughly over a period of seven years) for future development;

(e) draw the main implications of these scenarios for employment trends: new jobs in expansion, jobs in transformation and jobs in decline;

(f) identify the strategic choices to meet sector skill needs;

(g) identify specific implications for education and training of sector skill needs;

(h) formulate the main recommendations.

The European foresight methodology to identify emergent jobs and their skills needs is described below (Rodrigues, 2007).

A6.3.1. Framing a European foresight methodology on skills needs
A6.3.1.1. *Main features of the methodology*

(a) A forward-looking approach:

 (i) focusing on activities with relevant potential for jobs creation;
 (ii) identifying the main drivers and their implications for skills needs.

(b) Enabling a strategic conversation by identifying consistent, plausible but contrasting scenarios to support strategic choices by the main stakeholders.

(c) Keeping a flexible approach on occupations evolution, open to different combinations of competency units.

(d) Adaptable to different national contexts.

(e) Enabling two-way interfaces between foresight and forecast analysis, ensuring compatibility with the statistical classification of economic activities of the European Community (NACE), the international standard classification of occupations (ISCO) and the international standard classification on education (ISCED).
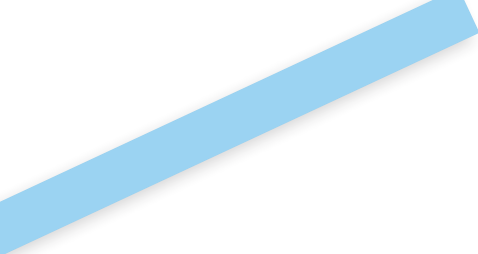
(f) Usable within short time frames and with limited resources.

(g) Focusing on different possible uses:

 (i) early identification of emergent jobs and skills needs;
 (ii) building qualification standards according to the levels defined by the European qualifications framework (EQF);
 (iii) supporting a credit system for transfer, accumulation and recognition of learning outcomes, as proposed by the European credit system in education and training (ECVET);
 (iv) curriculum development;
 (v) vocational guidance: possible use by the portal on learning opportunities throughout the European space (PLOTEUS) and the European jobs network (EURES);
 (vi) organisational development;
 (vii) human resources management at company, sectoral, regional, national and EU level;
 (viii) sectoral learning strategies and competency-building projects;
 (ix) partnerships for innovation, skills and jobs, in connection with high-level industrial groups, clusters, lead markets and technology platforms promoted at European and national level.

(h) Easy to use and adaptable by the main stakeholders.

A6.3.1.2. *Main research techniques*

The main techniques to be used are:

(a) statistical and forecast analysis;

(b) desk analysis;

(c) foresight techniques, notably systems analysis, scenario building and actor games; at this stage of the pilot project, their main purpose is neither simulation nor optimisation, but exploration of possible scenarios;

(d) web search;

(e) workshops involving top experts in the focused on economic activities, dealing with markets, technologies, human resources, research or education and training and coming from big, medium and small companies, business consultants and research, education and training institutions.

The selection of experts is crucial for the outcome of these workshops, as are the roles of chair and rapporteur. The preparatory phase is also particularly important in providing a good background report to all the participants. Previous interviews and meetings may be required for good preparation. Moreover, these workshops should be conducted with a precise methodology, as follows.

A6.3.2. Presentation of the methodology

Taking into account the framework already defined, we will now present a draft methodology for the expert workshop, assuming that it should be prepared for in detail and that its outcomes should be further developed by its rapporteur.

The sequence of steps to be performed, with clear direction by the chairperson and the rapporteur, should be the following.

Step 1: What are the main economic and employment trends and structures in these activities?

The aim is to present a brief stastical portrait of these activities, focusing on the industries under consideration in terms which are as disaggregated as possible in order to obtain statistical data:

(a) comparing EU and its main international partners;

(b) comparing Member States with the EU total in three different dates over the past 15 available years, if possible, when the purpose is to analyse the main trends.

It would also be very useful to take into account the projections to be provided by the project on pan-European skills forecasts.

To compare employment trends and the relative specialisation of the EU versus other international partners, the following would be particularly relevant:

(a) employment trends by industry in the EU, US, Japan and others (notably in BRICS);

(b) the same in vertical shares;

(c) the same in horizontal shares.

To compare the employment trends and the relative specialisation of the Member States:

(a) employment trends by Member State in each considered industry;

(b) the same in vertical shares, of each Member State/ total EU.

To measure the key economic trends:

(a) output trends by industry in the EU, US, Japan and others (notably in BRICS);

(b) trade balance by industry in the Member States;

(c) knowledge intensity by industry in the EU, US, Japan and others (notably in BRICS).

To measure the qualification content of each considered industry:

(a) employment trends by education level in each industry in the EU.

To measure the occupation structures of each industry:

(a) employment by occupation in the Member States in each industry in the EU;

(b) employment by form of work organisation in the Member States.

(Rodrigues, 2007).

Step 2: What are the main drivers of change in these activities?

Table A3 provides the grid which aims at identifying the main drivers of change with possible implications for employment and competency trends.
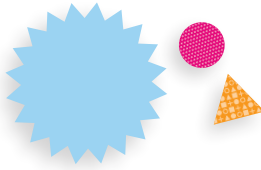
Table A3.   Main drivers of change in each activity

Main drivers activities	Technical product and services	Technical process	Economic demand	Economic supply	Organisational conceptual	Organis. executive	Others
Content industries							
Specialised software	Interactive software customised software	Automatisation	Very rapid increase, differentiation, price also matters	Network companies, role of start-ups and SMEs, outsourcing, offshoring	Specialisation, creative activity	Routinisation	
Generic software							
Computing hardware							
Telecommunication services							
Telecommunications hardware							

Source: Rodrigues (2007).

These drivers, defining challenges and opportunities are:

(a) in the economic dimension, the main trends in demand and supply;

(b) in the technological dimension, the main trends in process innovations and in product and service innovations;

(c) in the organisational dimension, the main trends regarding the more conceptual functions and the more executive functions.

The time horizon to be proposed for this exercise is seven years: 10 years would be too long and too risky, taking into account the present speed of change, while five years would be too short to organise large-scale initiatives at European level. Seven years is a relevant policy-making cycle in the EU, based on the financial perspectives and EU community programmes for research and technological development (RTD), innovation or lifelong learning.

Step 3. What are the main emergent competencies by function in each of these activities?

This exercise, assumes that:

(a) competencies can basically be of three types: theoretical ('knowledge' in ECVET, technical ('skill' in ECVET); and social ('competencies' in ECVET);

(b) competencies are combined in occupation profiles, where they can be core competencies, specialisation competencies or complementary competencies. Most occupation profiles are in permanent transformation through adding new competencies up to a point where emergent new occupation profiles can be signalled and recognised;

(c) these occupation profiles are quite often translated into qualifications standards, which are diverse across Member States, reflecting their different structures of education, work organisation, collective agreements and social identities;

(d) transnational cooperation to define common qualification standards in high-level education is taking place with the Bologna process; under the Copenhagen process, the same progressive change can take place for technical and vocational education and training (TVET), using the EQF as a common frame as well as the method proposed by ECVET. This system is based on units of learning outcomes combining the three types of competency.

Considering these assumptions, the current exercise to identify skills needs:

(a) should be general enough to accommodate the national specificities afterwards;

(b) should be focused on competencies and on occupation functions and not on occupation profiles, which are diverse across Member States. Nevertheless, if the need for a new occupation profile is clearly identified, it should be registered;

(c) should locate these competencies in a general grid defined by the main occupation functions: general management, marketing, financial and administrative management, research and development (R&D), logistics, production management, production, quality and maintenance. This grid should be connectable with the eight levels of the EQF;

(d) should not aim at an exhaustive listing of competencies in each occupation function, but at identifying some of the emergent critical competencies in each function, to meet the challenges defined by the main drivers of change. An exhaustive list of competencies can be found in several national occupation directories prepared by Member States;

(e) should take into account the need to define consistent competency units (or unit of 'learning outcomes' as named by ECVET), composed by theoretical, technical and social dimensions.

Table A4 helps identify new critical competencies by occupation function in the specialised software industry.
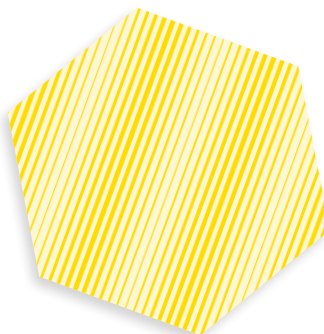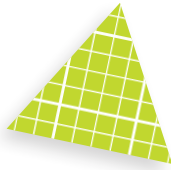
Table A4.   New critical competencies by occupation function in the specialised software industry

Main drivers	Economic demand	Economic supply	Tech. process	Tech. products/ services	Organisation conceptual	Organisation executive
Functions	Very rapid increase, diversification, customisation	Outsourcing, off-shoring	Automation	Interactive software	Specialisation, creative activity	Routinisation
General management	Focus on new customs needs	Global networking Intercultural management			Promoting creative environments	Improving control systems
Marketing	Exploring new market segments	Developing corporate image				
Financial and administrative		International finance management				
R&D		International cooperation and competition	Applying new languages	Improving mechanisms for interactivity		
Logistics		International supply chain				
Production management		International supply chain				
Quality						
Maintenance						
Production						

Source: Rodrigues (2007).
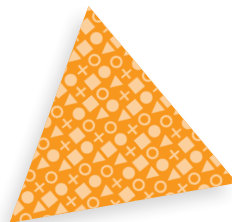
Step 4. What are the main scenarios and their implications for employment trends?

This exercise aims to identify different possible scenarios for the employment trends, to be defined in terms of specialisation patterns, taking into account the international division of labour:

(a) where some of the considered economic activities can develop, and others decline in Europe;

(b) where the more conceptual functions or the more executive functions can either develop or decline in Europe.

The possible employment trends are given by comparing the present situation with the possible future situation over seven years. This comparison is signalled below by:

(a) I, increase the employment level;

(b) M, maintain the employment level;

(c) D, decrease the employment level;

(d) ?, uncertain trend.

In answering these questions, the experts' opinions should be confronted with the statistical analysis on employment trends presented in step 3.

Table A5.   Scenarios and implication for employment trends

Active/functions scenarios	Content industries Conceptual executive		Specialised software Conceptual executive		Generic software Conceptual executive		Tele-communication services Conceptual executive		Tele-communication hardware Conceptual executive	
A. Expanding all activities	I	I	I	I	I	I	I	I	I	I
B. Expanding all activities except hardware										
C. Expanding conception, reducing execution	I	D	I	D	I	D	I	D	I	D
D. Focusing on specialised software, content industries and telecommunications										

Source: Rodrigues (2007).

These scenarios should be built on plausible trends and their consistent combination. It is then be possible to identify the most probable ones among them in analytical terms and, afterwards, the most desirable ones. It can also be useful to launch a number of 'wild cards' by suggesting some possible unattended scenarios.

All these contrasted scenarios provide the basis for a 'strategic conversation' in the expert workshop, which should then be deepened by looking at least two scenarios, one best and one worst, among the probable ones. This is the purpose of the next step.

Step 5. What are the implications of these scenarios for competencies and occupation profiles?

In this step, it should be possible to reach a central outcome of this methodology, by building on the previous steps.

First, it is necessary to deepen the analysis of at least two of the previous scenarios by specifying the implications for each occupation function in terms of jobs expanding, transforming or declining. Table A6 should be filled in by indicating the occupation function at stake.

Table A6.   **Jobs in expansion, transformation or decline in Scenario E 'Expanding in specialised software, content industries and telecommunications and declining in executive jobs in the other industries'**

Employment trends activities	New jobs in expansion	Existing jobs in expansion	Jobs in transformation	Jobs in decline
Content industries		All functions		
Specialised software		All functions		
Generic software		R&D, logistic	General managers, marketing, financial, production, quality	Production, quality
Computing hardware				Production, quality
Telecommunication services		All functions		
Telecommunication hardware		R&D, marketing, logistic	General managers	Production, quality

Source: Rodrigues (2007).

Building on the previous steps, particularly step 3, it should then be possible to describe the scenarios, as telling possible stories about the future, in the following terms.

In scenario E, 'Focusing on specialised software, content industries and telecommunications':

(a) the jobs in specialised software will expand, requiring new competencies, such as in general management: focus on customer needs, building global networks, intercultural management, promoting creative environments, improving control systems; in marketing, etc.

(b) the jobs in generic software, in computing hardware and in telecommunications software will decline.

This concrete story about the future can only be exemplified during the workshop. Its detailed drafting can only be carried out afterwards by the rapporteur, who will circulate it among the experts for their comments.

If there is a need to draw implications from these scenarios for some Member States, it is possible for them to adapt them using a correspondence grid such as Table A7. However, it is never possible to make a mechanical transposition of European scenarios to national scenarios, as several adaptations are required.

Step 6. What can be the main strategic choices to meet these skills needs?

In discussing this issue, it is important to bear in mind that skills needs can be met in quite different ways:

(a) changing work organisation;

(b) retraining employed workers;

(c) recruiting unemployed workers with or without retraining;

(d) recruiting young people coming from education, with or without retraining;

(e) recruiting workers from other Member States;

(f) recruiting workers from non-Member States;

(g) outsourcing and offshoring;

(h) other ways.

For an identified critical skills gap, it might be useful to draft a flow chart to identify possible solutions.

Step 7. What are some of the more specific implications for education and training?

Among the solutions to meet skills needs, many depend on new responses from education and training institutions. This methodology can support future choices by providing:

(a) Table A4 on the critical competencies by occupation function in each industry;

(b) Table A6 on jobs in expansion, transformation or decline;

(c) Table A9 on occupation profiles by function and industry in a specific Member State.

Step 8. Main recommendations

In conclusion, some recommendations can be formulated by building on the main outcomes of this methodology:

(a) a map of emerging economic activities and their main connections;

(b) the employment trends of these activities in Europe within a globalised economy;

(c) drivers of change and implications for critical competencies;

(d) new critical competencies by occupation functions;

(e) scenarios and implications for employment trends and competencies;

(f) a list of jobs expanding, changing or declining;

(g) recommendations to meet the skills needs;

(h) support to sectoral learning strategies;

(i) support to partnerships for innovation and jobs creation.

A6.3.3. Further developments to adapt European references to national or local conditions

The outcomes of this expert workshop will lead to references at European level which can be relevant but are necessarily quite generic and abstract. In order to adapt them to the national or local conditions, it is necessary to mobilise more information, involving key stakeholders at these different levels:

(a) strategic choices to be made by the different actors;

(b) framework conditions to develop the cluster and competency building;

(c) concrete occupation profiles in each occupation function;

(d) various choices to meet the identified skills needs.

The following tables provide a grid to extract this supplementary information.

Table A7.   Main corporate strategies by activity

Corporate strategies and activities	Main competitive factor Cost efficiency/product differentiation	Scope broadening/ specialisation in the range of products	Corporate structure vertical integration/networking/ outsourcing/offshoring
Content industries			
Specialised software			
Generic software			
Computing hardware			
Telecommunications services			
Telecommunications hardware			

Source: Rodrigues (2007).

Table A8.   Key framework conditions by activity

Key framework conditions activities	Research	Intellectual property rights	Human resources	Venture capital	Tax incentives	Infra-structures	Standards	Others
Content industries								
Specialised software								
Generic software								
Computing hardware								
Telecommunications services								
Telecommunications hardware								

Source: Rodrigues (2007).

Table A9.   Occupation profiles by function and activity in the EU Member States X

Activities	Content industries	Specialised software	Generic software	Computing hardware	Telecommunications	Telecommunications
Function/ EQF level						
General management						
Marketing						
Financial and administrative						
R&D						
Logistics						
Production management						
Production						
Quality						
Maintenance						
Function/ EQF level						

Source: Rodrigues (2007).
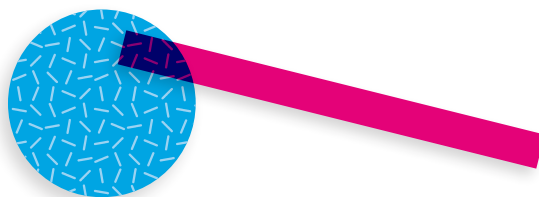
Table A10.   Strategic choices to meet skills needs

Choices to meet skills needs and activities	Changing work organisations	Re-training employed workers	Recruiting unemployed workers	Recruiting young people	Recruiting workers from other Member States	Recruiting workers from abroad	Offshoring and outsourcing
Content industries							
Specialised software							
Generic software							
Computing hardware							
Telecommunications services							
Telecommunications hardware							

Source: Rodrigues (2007).

A6.4.   Lessons learned

A series of forward-looking sector studies was elaborated under the European Community programme for employment and social solidarity (PROGRESS) (2007--13) using the European foresight methodology. They were completed in 2009.

The sectors covered were:

- non-energy extractive industries;
- textiles, garments and leather products;
- printing and publishing;
- chemicals, pharmaceuticals, rubber and plastic products;
- non-metallic materials (glass, cement, ceramic, etc.);
- electromechanical engineering;
- computer, electronic and optical products;
- building of ships and boats;
- furniture;
- electricity, gas, water & waste;
- distribution, trade;
- tourism including hotels, catering and related services;
- transport;
- post and telecommunications;
- financial services (banking, insurance and others);
- health and social work;
- other services, maintenance and cleaning.
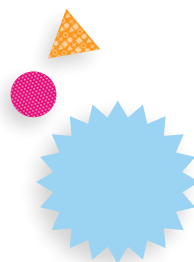
A6.4.1.   Use of the studies

Following input from the European Commission ([82]) these sectoral studies were disseminated to European sectoral social partners with the aim of encouraging debates between them about possible trends in their sectors. The results were also disseminated among the different services in charge of these sectors inside the Commission.

The main message for the Commission is the importance of creating sectoral capacity to update these first studies (for example, to take on board the economic crisis). Given the lack of a space for sharing information about sectoral trends at European level (national sectoral observatories may exist but any exchange between them is at European level), the Commission supports the concept of European sectoral councils.

This concept will be an element of the EU skills panorama ([83]), the aim of which is to develop links with the services in charge of education ([84]).

References

European Commission (2007). *Comprehensive sectoral analysis of emerging competences and economic activities in the European Union*. Invitation to tender No VT/2007/090. Tender specifications. http://ec.europa. eu/social/main.jsp?catId=624&langId=en&callId=86& furtherCalls=yes

Rodrigues, M.J. (2007). *Innovation, skills and jobs*. Pilot-project to develop a European foresight methodology to identify emergent jobs and their skills needs. Working document 8.3.2007.

Websites

[URLs accessed 21.5.2014]

European employment strategy http://ec.europa.eu/social/main. jsp?langId=en&catId=101

EU skills panorama. http://euskillspanorama.cedefop.europa.eu/

PROGRESS programme 2007–13. http://ec.europa.eu/ social/main.jsp?catId=327
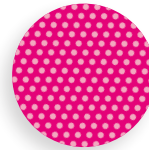
([82]) Reply of Jean François Lebrun, Advisor EMPL/C, European Commission, on the email request No 19965 from 29.5.2013.

([83]) http://euskillspanorama.cedefop.europa.eu/

([84]) See the EU employment strategy: http://ec.europa.eu/social/main.jsp?langId=en&catId=101

ACRONYMS

ECVET	European credit system in education and training
EQF	European qualifications framework
R&D	research and development
TVET	Technical and vocational education and training
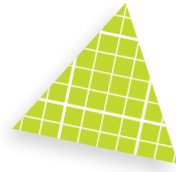
ANNEX 7.
Skills foresight in the EU enlargement region

A7.1. Introduction

The European Commission has entrusted the European Training Foundation (ETF) with supporting enlargement countries ([85]) in their human resources development (HRD) efforts. The overall objective is to assist the countries in developing the skills of their people for sustainable economic development and social cohesion in a medium to long-term perspective. The ETF initiative is part of the drive to support the implementation of the second cycle of the European Union (EU) instrument for pre-accession assistance 2014–20 (IPA), which requires a future-oriented strategy.

Foresight is one of four components of the ETF project and will be complemented with a review of institutional arrangements and monitoring at national level, as well as regional cooperation among the enlargement countries. At national level, the aim of foresight is to elaborate a commonly agreed vision and a roadmap for skills 2020 in a wider human resources development context.

Skills will be at the centre of the foresight initiative in the enlargement countries, addressing the question 'Which skills should the country develop towards 2020, and how can these skills be generated by the education and training system?'

This case description draws on the experience to date in implementing foresight in two enlargement countries.

A7.2. Economic and social context

Enlargement countries need to ensure a more coherent and evidence-based policy approach to human resources development and improved institutional and interinstitutional cooperation. Strengthening evidence and capacity for better institutional performance will lead to a better match between education and training and the needs of the economy and the labour market. A more strategic approach for developing a vision for human resource development needs to be adopted.

The rationale for skills anticipation in the enlargement region is not only to minimise labour market failure and to ensure better careers and lives for individuals; there is also the additional purpose of informing programming for the next cycle of EU structural funds, for example, IPA for the period 2014–20.

A qualitative approach is applied to developing a vision for skills 2020, taking broader issues and trends into account and building on existing evidence.

A7.3. Main challenges and policy objectives

Key stakeholders in the countries have recognised the need for policy coherence and have outlined strategic development goals in education, employment and social inclusion in national and regional development plans, in sector policies and programmes and in related strategies. What is needed is to derive implications for skills from these strategies.
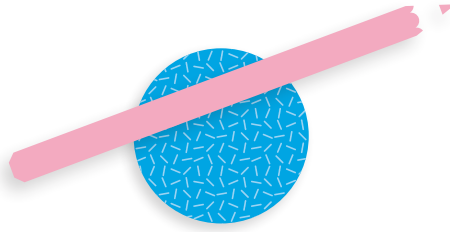
Figure A6. Vision for skills 2020

The foresight question:

Which skills should we (the country) develop towards 2020, and how can these skills be generated by the education and training system?

Evidence (key indicators) (current situation, key data)

Anticipation (national and international forecasts of demand and supply)

Strategies coherent view of existing strategies with skills relevance

Drivers (macro economic trends, FDI technological innovations ...)

Vision for skills 2020

Values (social inclusion, equal opportunities, territorial coherence, CSR ...)

EU Integration, EU 2020 strategy, SEE 2020 strategy, benchmarks ...

Education and training system in a lifelong learning perspective (VET and Higher Education)

Major efforts are being made in the region to match the needs of the labour market with training and skills development. These efforts aim at reducing the mismatch of demand and supply of skills and supporting the economic and social development of the countries. All countries have been working on national HRD strategies, with more or less success, in focusing on skills and in transforming strategies into concrete and forward-looking measures. A key aspect of the problems faced by the countries relates to the capacity of institutions for implementation and interinstitutional cooperation and coordination. While countries recognise the need to strengthen their policies to make HRD a cornerstone of their economic and social development, a shared vision among all stakeholders and institutions, as well as the means to implement an effective policy cycle, remain top priorities.
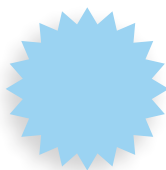
The key objectives of skills foresight in the enlargement region are:

(a) to break down silos between ministries and to develop more joined-up policy approaches for skills, bringing together the key players in the sector and drawing together the HRD component in these strategies and identifying the interfaces between them;

(b) to promote a more future-oriented approach to skills policies, paying attention to key stakeholders (private sector, civil society) which may not have been sufficiently engaged in the development of the strategies;

(c) to flag key concerns in relation to skills, in particular the mismatch between demand for and supply of skills;

(d) to promote capacity-building for the HRD policy cycle with regard to the implementation of EU support provided under IPA.

Interinstitutional cooperation for better coordination, monitoring and implementation of the many strategies has increased but still needs substantial improvement. There are platforms and councils in most of the countries to discuss issues related to skills policies, job creation, employment, or social inclusion, but their role and capacity are still limited. Social partners have been involved in developments at system, regional, sectoral and local level, but not sufficiently.

The qualitative foresight approach adopted should be supported by quantitative data on skills anticipation and robust evidence. In most countries of the enlargement region, quantitative forecasts and a coherent labour market information system remain to be improved.

A7.4. Key institutions, approach, process and results

A7.4.1. Institutions involved and active

Participation in the foresight process ensures representation of the main government institutions with a stake in the HRD sector, economic actors and civil society. The institutions involved are the ministries of finance and European integration, line ministries (labour, education, social affairs, research, the economy), government agencies (public employment services, agencies for vocational education and training and for higher education), social partners and civil society organisations. In line with the management system for EU structural funds in place, a coordinating government institution is nominated which takes the lead to drafting and disseminating the results and forwarding them for adoption to the government.

A7.4.2. Approach

Foresight for skills 2020 in the enlargement countries also aims at informing the programming process for IPA, contributing to the best use of funds. There are particular features of foresight which distinguish it from other strategic planning processes:

(a) systematic: in the sense that it involves a well-designed approach based on a number of phases and using appropriate tools;

(b) participatory: since it brings together a wide range of stakeholders and encourages interactions, networking and learning;

(c) future intelligence gathering: studying trends and drivers, their interactions and possible disruptions, thereby allowing more evidence-based policy approaches and a level of anticipation;
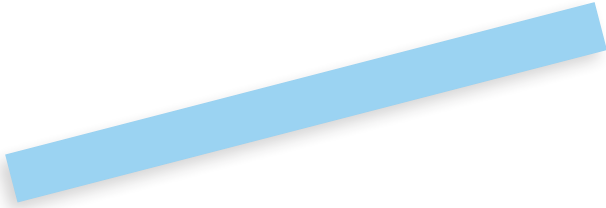
(d) vision-building: exploration of alternative scenarios supports the eventual focus on a common vision and consensus-building;

(e) shaping decision-making: foresight empowers the participants to move beyond exploration to shape the future through more proactive thinking;

(f) mobilising action: by engaging stakeholders it supports the pathway to effective policy implementation through joined-up approaches.

A7.4.3. Process

The foresight process basically consists of four main phases: preparation, system building, foresight proper, and follow-up to ensure the best use of the results.

Following this general design, specific actions were implemented in the first two countries where foresight had been carried out.

During the system-building phase, national government institutions and agencies, social partners and donor organisations were consulted. A government institution responsible for overall coordination of the foresight process was assigned, and further stakeholders consulted and invited to participate. The added value of foresight and expectations were discussed with the main stakeholders.

Milestones of the 'foresight proper' process were three workshops, but it also included work done between these events, such as drafting inputs and summarising results, as well as consultation meetings. All work was done in the local language and translated into English.

Table A11.   Overview of phases and tasks

Phases	Tasks/steps
Pre-foresight	Basic preparation of the exercise; preliminary analysis of reference documents in HRD; information gathering among a wider group of potential stakeholders; mapping of existing government strategies.
System building	Identification and commitment of participants; securing political and technical support and resources; identification of participants (involving relevant stakeholders in the exercise).
Foresight proper	Issue analysis, strategic panorama and its skills relevance; trends and drivers at global and national level; developing success scenarios; developing a shared vision, setting priorities and elaborating roadmap.
Follow-up	Ensuring commitment after the exercise; documentation of the foresight process and results; formal debriefing of results with key policy-makers; communicating results to a wider audience.

Source: Casingena Harper et al. (2014).
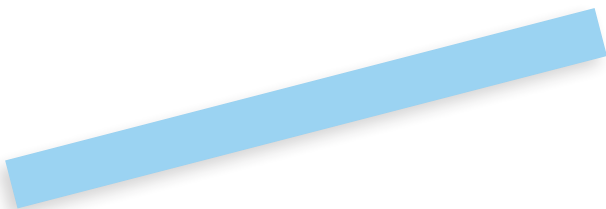
Workshop 1

This workshop brought together more than 30 stakeholders. To place developing the skills vision in the wider context of the country's macroeconomic strategy, government representatives presented the key national strategies. To complete the wider context, the main goals and comparative benchmarks of the Europe 2020 strategy for growth and jobs and the south-east Europe regional growth strategy 2020 were also brought in. A strategic panorama, mapping the core national strategies, was prepared and the consequent key issues and gaps discussed. This underlined the need to develop a coherent and forward-looking approach over the mid-term. Current issues and problems were discussed in breakout groups, covering the supply side, the demand side and cross-cutting issues related to human resource development.

Workshop 2

This workshop started with further exploration of demand side issues, debating what is currently done to anticipate future skills demands. A presentation of economic, social and technological global trends and drivers inspired a debate about their likely relevance and impact on the national skills system. Breakout groups worked on success scenarios, developing future visions linked to the main issues and defining the main actions to be taken to achieve these future visions. The workshop concluded with first drafts for a skills vision 2020.

Workshop 3

This workshop was a key element in the vision-building process. To ensure the policy relevance of the vision, key government institutions highlighted their core strategic priorities, followed by identifying and defining shared priorities which require a coherent approach and cooperation among stakeholders.

During the follow-up phase actions were taken to complete and finalise the roadmap, specifying how the vision will be realised. Clustered in a few (four) policy priorities, activities and measures were defined, each with the specification of the main responsible and coordinating bodies and the objectives to be achieved. These objectives were specified in terms of qualitative and quantitative targets, with result-oriented indicators. Baseline targets and targets to be achieved by 2020, as well as interim targets, remain to be fine-tuned with the support of monitoring experts. Among the priorities were systemic issues that will be further elaborated in the course an institutional capacity review which is foreseen within FRAME [86].

Results

The result to be achieved for each country is a concise vision for skills 2020, containing a joint vision statement, policy priorities, and a roadmap for how to make the vision real. The results are documented in the form of a short and concise paper, proposed for endorsement by the government and used as input for IPA 2014–20 programming.

Foresight is process-oriented work, undertaken together with key national stakeholders. Cooperation between different stakeholders – involving different government organisations, social partners, civil society organisations and researchers – is not a new practice. However, foresight works best with a shared understanding that this is a change management process which requires regular and long-term engagement.

The added value of foresight as tool for strategic and future-oriented policy development lies not only in a well-documented result but also in the process. The experience enhances the adoption of a future-oriented mindset among stakeholders. The process does not end with the elaboration of a vision for skills; regular monitoring will ensure sustainable results and a tangible impact. As a management process, the foresight experience helps to develop future intelligence that can be applied for further, in-depth foresight studies.

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[86] ETF FRAME project: http://www.etf.europa.eu/web.nsf/pages/Frame_project

Figure A7.   Process of foresight

The question for foresight:
What skills should we (the country) develop by 2020 and how can the education and training system develop these skills?

FORESIGHT MILESTONES	MAIN ACTIVITIES	SCHEDULE
Pre-foresight	**Basic preparation** Preliminary analysis of reference documents, ensuring political and technical support and resources **Commitment of decision makers** Information and coordination with key decision makers and stakeholders	November–December 2012
System building, fact finding	**Dialogue with stakeholders** (line ministries, National Employment Agency, social partners, state statistical office, EUD, donors, etc.), organisation of workshops, agreement on agenda, joint preparatory meeting of key stakeholders	January–February 2013
FORESIGHT MILESTONES	MAIN ACTIVITIES	SCHEDULE
Workshop 1	Launch of foresight: introduction to the process, team building, strategic panorama (mapping existing strategies), presentation of key macro-economic and development strategies; group work on issues	February 2013 (1 day)
Workshop 2	Global trends and drivers and their relevance for the country, developing success scenarios and a first draft of vision statement (breakout groups)	March 2013 (1.5 day)
Workshop 3	Vision workshop, setting priorities and elaborating a roadmap Result: draft Vision for skills with priorities and roadmap	April 2013 (2 days)
Follow-up	Result: Vision for skills with priorities and roadmap validated, edited and finalised Paper submitted for adoption by the government	May, June 2013

To provide an example of the overall process, timing and steps are depicted above in Figure A7.

A7.5. Lessons learned

The process design for foresight needs to be tailored to the specific framework conditions in each country and each case. There are many variations and differences in the institutional set up and the timeliness of exercises compared to other processes. Previous experiences and – most important – parallel activities with similar future-oriented processes need to be considered and synergies explored.

Alternative process designs may also be considered. The vision-building process may involve much wider groups, including larger parts of the business community and civil society. But when it comes to setting priorities and elaborating the details of a roadmap, small groups of decision-makers and experts may work most efficiently in achieving good results.

It is important to build on past experiences and on national expertise, with the involvement of researchers. When working on skills, the opinions of employers, human resources (HR) managers of companies in key industrial sectors, and owners of small companies may certainly bring in additional insights. It is not enough just to involve employer representatives.

Also important is scoping the foresight question, with a clear thematic focus for the process. Addressing 'skills' as such is like using a wide-angle lens: while this has advantages in terms of coherence, a view with a telephoto lens (for example, addressing an economic sector, a specific industry or [subnational] region) might lead to more concrete and practice-relevant results.

Reference

Casingena Harper, J. et al. (2014). *The future FRAME foresight guide for skills 2020*. Turin: European Training Foundation.
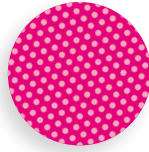
Website

[URL accessed 22.5.2014]

ETF FRAME project, skills for the future. http://www.etf.europa.eu/web.nsf/pages/Frame_project
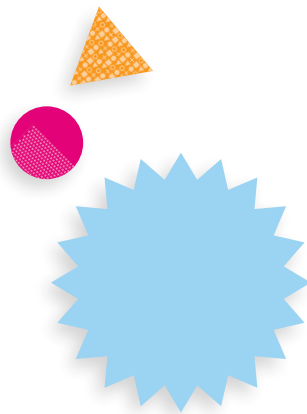
ACRONYMS

|	
ETF	European Training Foundation
HRD	human resources development
IPA	instrument for pre-accession assistance

A8.1.   Economic and social context

Similar to most industrialised countries, Russia is experiencing growing mismatch between the demand for labour with specific skills and competencies, and the training and education provided by the vocational and tertiary education system. One of the causes is accelerated technological progress, with the introduction of new technologies and methods into various industries and economic sectors, plus intensified global competition. The cycle of technological renovation is getting shorter even in more traditional industries (such as agriculture, natural resource extraction or construction), from decades to years; in new and emerging industries (such as information and communications technology (ICT) or biotech) substantial revision of technologies can take just a few years, and in some cases as little as 12 to 18 months.

The 'normal' process of coordination between education and training and labour markets, involving recognition of new tasks, adoption of new education and training programmes, and subsequent preparation of new specialists, today risks that demand for these specialists will disappear even by the time they complete their education. Additional investment in training will then be required to close the skills gaps. In Russian vocational education, the complete cycle from communication of a new skill demand to new specialists being ready can take between two and three years; in tertiary education, this cycle can take between four and six years. As the education system is often inflexible and unable to recognise new labour market needs, the cycle becomes even longer.

Figure A8.   Growing mismatch between training and new skills demand due to increased rate of technological change
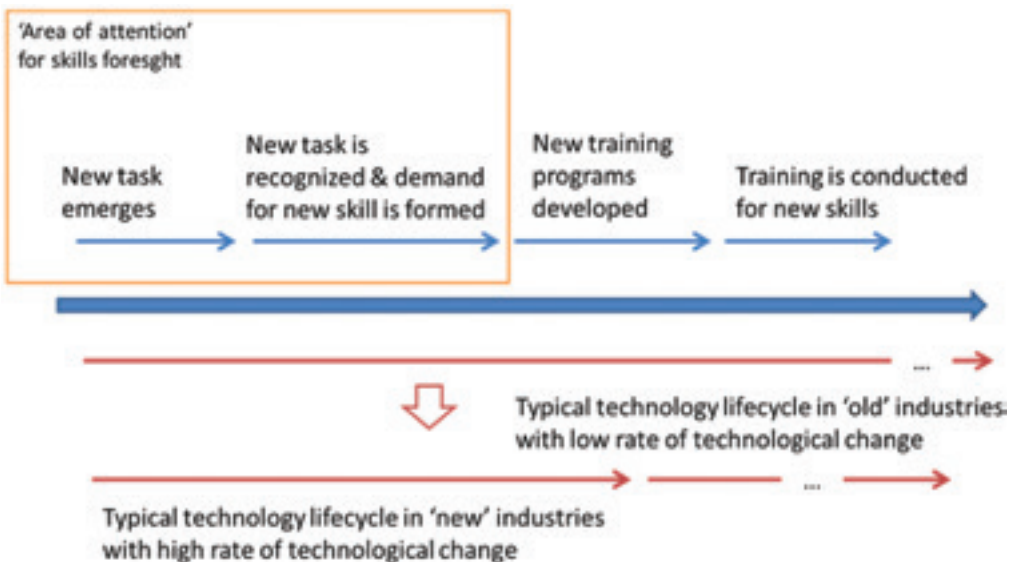
Source: Authors.

A8.2. Main challenges and policy objectives

The inability of tertiary education to adapt to labour market needs has caused severe mismatch: according to December 2012 statistics from the Ministry of Labour of the Russian Federation, only 43% of new specialists in the formal sector of the Russian economy find jobs in accordance with their qualifications. In the informal sector, the gap is even higher: only 24% work in accordance with their qualifications.

One of the ways to cope with this challenge is to reorganise the cycle through replacement of demand recognition with demand anticipation (Figure A8). This allows an industry's technological development to be aligned with human capital development, and prepares specialists for industry challenges that may unfold in the future. Also, because the foresight process establishes communication between employers and education institutions, this allows better synchronising even for existing labour demand.

The current context of the skills 2030 foresight project is set by growing pressure to revise industrial policies in Russia. Sectors that have been primary drivers of economic growth through the 2000s (oil and gas, steel and mining, and defence) are now stagnating. Technologies in infrastructure sectors (transportation, energy) are obsolete, and substantial investments into modernisation will be required through the 2010s. The government is also considering the possibility of using some of the Russia's competitive advantages, such as the relatively high quality of its technology and engineering education, to create new drivers of economic growth such as in the information and telecommunication sector or aerospace.

Four key factors in establishing the need for the skills foresight in Russia are:

(a) changing technologies, processes and managerial approaches in the economy resulting from technological progress and social innovations;

(b) increasing global competition for consumer markets and skilled labour;

(c) government efforts to modernise industries and launch the new 'knowledge economy';

(d) declining quality of the Russian system of tertiary and vocational education and training, and its inability to cope with international standards.

A8.3. Key institutions

The skills 2030 foresight in Russia was launched in 2011 by two government areas:

(a) the Ministry of Education and Science of the Russian Federation launched a study of demand for new skills and competencies in high-technology industries as a part of its third science and technology foresight;

(b) the Strategic Initiatives Agency for the President of Russian Federation launched the competency 2030 foresight as part of its initiative to create a national system of qualifications and competencies. This is a comprehensive project coordinated through the roadmap that involves activities in several ministries, including economic development, labour, education and science, and telecommunications and mass media.

The team at Moscow school of management Skolkovo was responsible for the execution of both projects. The project for the Ministry of Education and Science involved key high-tech sectors, including biotechnology (including agriculture and food industry applications), healthcare, ground transportation systems, aerospace, energy generation and transmission, information and telecommunications, extraction and processing of mineral resources, environmental protection and waste management. Additional sectors for the Strategic Initiatives Agency project involved construction, finance, education, government and public services.

A8.4. Skills 2030 foresight process, methods and results

The skills 2030 foresight was conducted for sectors where technology is the primary driver of change in skills demand (high-tech sectors and technology-dependent industries). The main focus of the foresight was to assess how key trends and new technologies

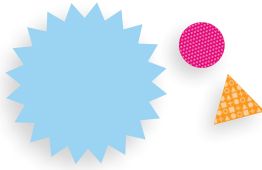change the nature of work tasks, shifting demand for existing and new skills.

The study of the demand for competencies consisted of (Figure A9):

(a) general economic analysis: definition of global and country challenges for the future. This phase was conducted by systematising key international studies on megatrends and challenges of the future, as well as through a cycle of interviews with leading economists, analysts, and industry experts in Russia;

(b) industry analysis: systematisation of Russian and international industry forecasts of scientific, technological and economic development. This stage allowed the determination of the technological and social factors driving industrial change;

(c) formation of expert groups including representatives of large, small and medium enterprises (SMEs) in the sector (i.e. employers), representatives of research institutions and universities, and representatives of professional associations, regulators and advisors working with the sector. Employer organisations were expected to be listed in industry rankings (including SMEs that were listed as 'most innovative' or were supported by leading Russian development agencies) and were expected to be involved in collaboration with universities in the development of new education programmes. It has also been found productive that between one-third and one-quarter of participants are industry 'outsiders': suppliers, users of industry products, and students in industry-related programmes;

(d) foresight session (see below for details);

(e) post-session verification of reports through roundtables and questionnaires.

Figure A9.   Key steps of the skills foresight study

Preliminary sector analysis, hypotheses regarding drivers of change
Formation of expert groups (employers, research sector, universities, professional associations, regulators, advisors)
FORESIGHT SESSION
Revision of results and preparation of reports
Report verification with additional expert pool
Final reports

Source: Authors.

The core of this study was foresight sessions. These focused on the collaborative design of the industry 'map of the future' through structured discussion (Figure A10):

(a) analysis of key trends that drive change in the sector, and discussion of new 'hard' technologies (new equipment, production processes) and 'soft' technologies (new managerial methods, new organisational formats) resulting from these trends. These 'factors of the future' were analysed across three time horizons: short-term (next three years: 2012–15), mid-term (following five years: 2015–20), and long-term (following decade: 2020–30). Around 12 to 15 key trends and soft technologies, and around 15 to 20 new 'hard' technologies were identified during this discussion;

(b) analysis of new market opportunities (products and services) and new market threats formed by trends and new technologies. Identification of changes in working tasks due to changing industry technologies, new opportunities and new threats that the industry has to deal with;

(c) identification of working tasks that are similar to existing working tasks (and can be resolved with existing skills and knowledge), become obsolete due to changing technologies and industry context, and emerge due to changing industry context. Working tasks were identified for intellectual and manual labour;

(d) for new tasks that cannot be resolved with existing skills and knowledge, new core competencies were identified; some were described through samples of best practices that may exist in other countries or in other industries, and some were described through requirements for new knowledge and skills. Between eight and 12 new competencies related to technological change were identified in every industry. Also, between three and eight competencies in every industry were either cross-sectoral or meta-competencies, which allowed for some of the study generalisations (see below);

(e) accomplished during verification sessions: participants also evaluated whether competencies will be widespread (most industry workers are supposed to master them) or narrow (only a few specialists would be required). Participants also discussed how these competencies can be formed (for example, change in education programmes, use of simulators, on-the-job training).
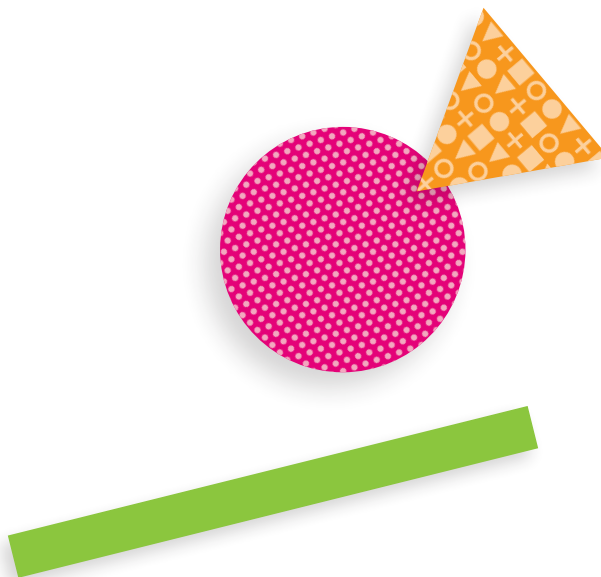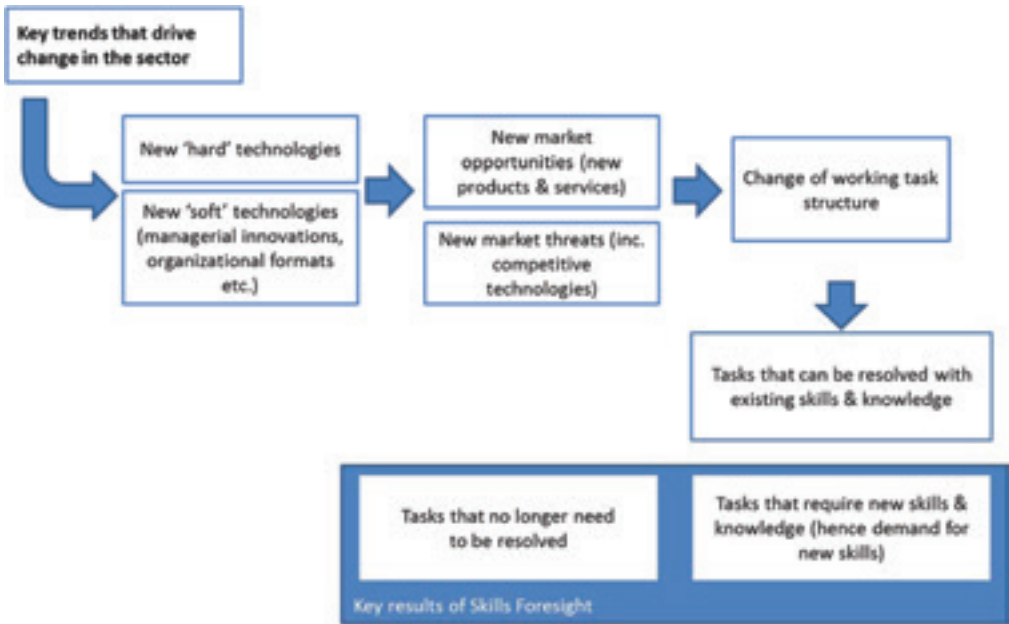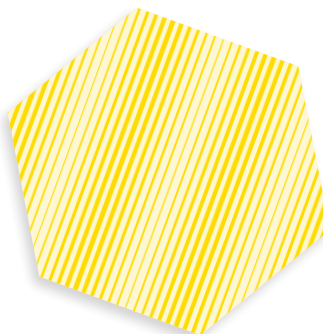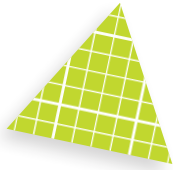
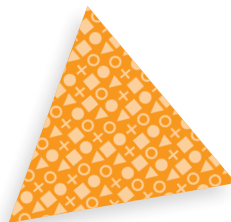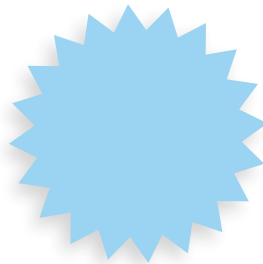**Figure A10.   General methodology of foresight sessions**

Results of the skills 2030 foresight

Apart from new competency maps for key high-tech and technology-driven sectors (which cannot be presented here for reasons of confidentiality), the study has also produced two generalisations: key competencies will be required in all technology-driven sectors; and key managerial competencies required in high-tech sectors will become new drivers of economic growth.

Three factors that influence all technology-driven sectors are (Figure A11):

(a) rapidly increasing competition (sometimes dubbed 'hypercompetition'). This trend leads to increasing innovativeness (seen as the key competitive advantage) and thus a higher rate of technological renewal (calling for flexible production systems), and also to increased control over consumer and supplier markets (direct economic power as well as indirect influence through sophisticated marketing and supplier network management);

(b) increasing (international) cooperation in research and development (R&D) and production. Despite increased competition, industry leaders also often collaborate to share investment resources, human capabilities and knowledge pools (thus the phenomenon of 'collaborative competition', dubbed 'coopetition'). Industrial innovation and rapid growth often occurs on the borders of disciplines or industries, dissolving 'traditional' knowledge and production domains;

(c) digitalisation/automation: ICT penetrates all industries and domains of human activities, changing the nature of manual and intellectual labour. All routine operations, whether manual or intellectual, are gradually automated, and workers shift from actually doing their work to programming devices to do their work. The proportion of non-routine activities (creative work, especially in teams, and related communication and management processes) increases and relevant competencies become mandatory for workers of the future.
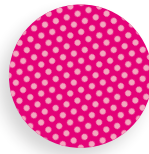
Figure A11. Key factors changing working tasks in all technology-driven sectors of the Russian economy

Key trends	Derivative trends
Growing international cooperation in R&D and production	Consumer focus
Lifecycle approach to product portfolio management
Increased control of large players over key consumer and resource markets
Hypercompetition: intense global competition for consumer markets	
Growing rate of technological change	Growing flexibility of production
Automatization & digitalization: impact of ICT sector on other sectors	Automatization of routine intellectual labor
Dissolving industrial and disciplinary borders, cross-disciplinary innovations	

Source: Authors.

Key competencies of the 'worker of the future' resulting from these trends are presented in Table A12, divided into technical competencies, competencies for working in a global context, cross-professional competencies and meta-competencies.

Table A12.   Key competencies of the Russian worker of the future

Key competency areas	Key competencies
Technical skills and knowledge	Multidisciplinary background: from T-shaped to M-shaped workers Technical + economic background
Skills and knowledge for global contexts	Foreign languages Cross-cultural competencies Knowledge of global practice domain (for example, standards, design environments, etc.)
Cross-professional competencies	Creative collaboration (co-creation) in project teams Communication skills Working with large volumes of information
Meta-competencies	System thinking 'Programmer thinking' (working with programmable environments) Rapid learning and re-learning (adaptation to various working contexts) Self-development skills Self-regulation skills

Source: Authors.

Another generalisation concerns the key skills and knowledge required for the creation and development of new high-tech sectors in Russia, such as ICT, biotech, smart grids, and smart transportation. In every industry considered, four competency types have been identified, in addition to industry-specific technology specialists. These competency types are combinations of key competencies required to launch and maintain a knowledge-based economy, including design, production, transfer of technologies, integration of new activities, and adaptation and standardisation of products (see Table A13). All of these competencies require a combination of technological and managerial education, training and experience.
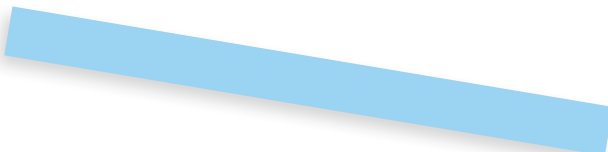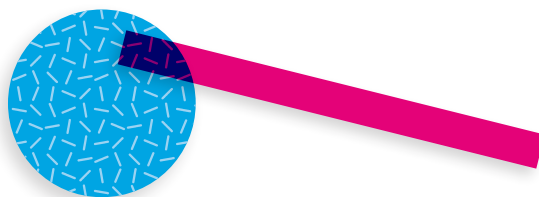
Table A13.   Four competency types for knowledge-based sectors of the Russian economy

New skill cluster	Work tasks	Key competencies
'Integrators' (including technological entrepreneurs)	End-to-end organisation of innovative production from an idea to a product on the market	Business management and technology (understanding innovative activities across the product life cycle)
'Translators' (cross-discipline/inter-industry)	Cross-discipline/cross-industry transfer of technologies (markets for new products in mature industries)	Understanding technologies and processes in at least two industries Marketing competencies
'Adaptors'	Product adaptation to customer demands; design (including interface design and usability)	Requirements management Client behaviour patterns Design competencies
'Standardisers'	Development of industry standards (with regulators or through self-regulation)	Management (negotiations, lobbying, promotion) and basic technology

Source: Authors.

These competency types are required at different stages of the industry life cycle, as the industry environment moves from early growth into more mature stages. During the early stages, integrative competencies (to help launch new enterprises, stimulate business and the regulatory environment) are required, then industry is able to work with evolutionary innovations (that involve minor and gradual product improvements); during the later stages, industry leaders, through their innovative ecosystems, are able to launch and maintain disruptive innovations (that require the collective efforts of supplier and distributor networks, often of hundreds and thousands of independent enterprises).

Figure A12.   Emergence of new competency type in knowledge-based sectors of the Russian economy

	2012-15	2015-20	2020-30
Key working tasks for knowledge-intense economic sectors	Integrated organization of R&D and production process for knowledge-intensive products	Working with markets to improve existing products (evolutionary innovations)	Creation & implementation of families of new products & solutions (disruptive innovations)
Key competencies	Integrators Translators Specialists to support industrial rennovation process	Adaptators Standardizers	System architects, technologists and safety experts

Source: Authors.

A8.5.   Lessons learned and next steps

Summarising these findings, our team concluded that:

(a) a substantial share of new competencies in technology-driven sectors are cross-professional or meta-competencies that go beyond the demand for competencies in specific sectors. Multidiscipline ability is among the key competitive advantages of the 'worker of the future';

(b) for knowledge-based sectors, an 'ecosystem' approach is most productive: creation/preparation of teams with inter-dependent competencies that allow inventing, designing, marketing, producing and supporting new products;

(c) future-oriented approach to skills and knowledge demand is necessary for the development of new industries. However, few employers are ready to discuss their future needs. The key problem here is that most industries are lacking 'translators' that could help connect strategic planning, technological development, and human resource preparation in the industry domain.

Project development

The skills 2030 foresight results have been communicated to the Ministry of Education and Science, the Agency of Strategic Initiatives, and a number of innovative forums, where its results were evaluated. However, the priority of our team is to have tangible results with observable social and industry impact. Therefore, the foresight process is planned to continue to the end of 2013 and beyond. Among key scheduled activities are:

(a) 'grounding' of key foresight findings in the context of specific industries to revise education programmes for industry-related universities and vocational training institutions. Since late 2012, this work has begun for the aerospace sector in collaboration with United Aircraft Company, the largest aircraft producer in Russia. Other sectors are anticipated to follow through spring and summer 2013, including the transportation industry, and the nanotech/new materials industry;

(b) creation of the career guidance tools (including Navigator through 100 jobs of the future and 30 jobs that will disappear in the next 15 years) for the Russian public (youth and their parents), to be published summer 2013;

(c) creation of a short-term/mid-term and long-term demand anticipation tool in collaboration with the Ministry of Labour (as part of the roadmap for a national system of qualifications and competencies), to be implemented in pilot regions of Russia through 2014.

ACRONYMS

ICT	information and communications technology
SMEs	small and medium enterprises

A9.1. Policy context

Australia is one of the few developed countries which have weathered the effects of the global financial crisis well, and its economy has remained in a strong position. This is primarily due to an uninterrupted resources boom, accompanied by significant capital investment in the mining-related sectors of resource-rich states. At the same time, trade-exposed sectors, such as manufacturing, tourism and education have been negatively affected by the increasing terms of trade. This has created a 'patchwork' economy, as those states where the proportion of these sectors is higher in the economy are growing at a slower speed.

A9.2. Main challenges and policy objectives

Skill and labour shortages have been prevalent features of the Australian labour market for a number of years. While shortages in trade-exposed sectors have eased due to recent changes, they prevail and are seen as constraining growth in other sectors. The labour market also faces a number of challenges in the long term, such as the ageing population and slowing labour productivity growth. Addressing these issues through the creation of a high-skilled, world-class labour force has been the primary focus of government workforce development policies. Training policy responses are being formulated to aid structural adjustment of the labour market.

The top issues for the future of work and jobs in Australia were expressed in key questions at the October 2012 conference 'The future of work – Developing Australia's workforce in a global economy' organised by leading institutions in the field, the Australian workforce and productivity agency and industry skills councils. Some of the questions explored at the conference were:

(a) what does the state of the nation in 2025 look like?

(b) what are the major changes looming that will affect work and productivity?

(c) what will be the impacts of the 'Asian century', for the economy, for jobs, for learning/skills development?

(d) what are the implications for the tertiary sector of meeting the skill needs of employers and individuals?

(e) are improvements in labour productivity the key to continued prosperity?

(f) what are the implications for various industry sectors of all this?

(g) how will the fast pace of change in information and communications technology (ICT) and social media/social networking change the way we work?

(h) what is the impact of technology?

The event promoted dialogue, raising the profile of the challenges and solutions around developing the future of Australia's workforce in a global economy.
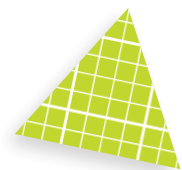
A9.3. Key institutions, processes, methods and results

The sectoral approach has been a key feature of vocational education and training in Australia. The key institutions in the sectoral skills development framework are the national and state/territory level industry skills bodies.

A9.3.1. Australian workforce and productivity agency (AWPA)

The Australian workforce and productivity agency was established in 2012 to support the formulation of workforce development policy and advice, and direct skills funding to industry needs. The AWPA's key objectives are to sustain economic growth, avoid future skills shortages and raise productivity by increasing and deepening the skills of Australia's workforce. To achieve these objectives the AWPA engages directly with industry on workforce development issues and to address sectoral and regional industry needs.

The AWPA's membership provides balanced representation of industry, employees and employers, and includes experience from academia, training provision or education, economics, industry and employee representatives.

The agency has replaced Skills Australia, with expanded roles and functions. As an independent statutory body, Skills Australia's main role was to advise the Minister for Education, Employment and Workplace Relations on Australia's current, emerging and future workforce skills and development needs. Building on this remit, the AWPA is responsible for:

(a) skills and workforce research, including into the quality of jobs and future working life in Australia;

(b) providing independent advice on sectoral and regional skills needs to support workforce planning;

(c) driving engagement between industry, training providers and government on workforce development, apprenticeships and technical and vocational education and training (TVET) reform;

(d) administering the new national workforce development fund, and prioritising industry sectors, regions, and groups for funding;

(e) developing sectoral skills and workforce development plans in conjunction with industry skills councils and industry;

(f) promoting workforce productivity.

A key addition to the functions of the AWPA is the administration of the newly created national workforce development fund. The fund is an Australian government programme that supports the training of existing and new workers in areas of identified business and workforce development need. Industry skills councils (ISCs) participate in the administration of the fund, as they assist businesses with identifying their training needs, selecting a registered training organisation, and monitoring the implementation of projects.

The AWPA provides research in a number of key workforce development areas. They prepare the specialised and skilled occupations lists, which provide the basis of the skilled migration programme. They also undertake work on skill needs and workforce development in specific sectors, including in the resources sector, the defence industry and green skills.

Most importantly, the AWPA has established a rigorous process to formulate a national workforce development strategy in 2010, with the second, updated national workforce development strategy released in 2013. The process involves three key stages of research and analysis.

In the first phase, a number of scenarios are developed to identify what factors are likely to drive demand and supply for skills in the Australian labour market to 2025. The scenario approach acknowledges the limitations of economic modelling methods, particularly in accurately forecasting over the long term. The scenarios provide plausible alternative futures for the Australian economy through which common outcomes and key uncertainties and risks can be identified, so strategies that take account of uncertainty can be developed.

The scenarios take into account: social, demographic and cultural trends; economic and financial trends and globalisation; labour force, industrial and workplace trends; science, technology and innovation trends; governance and public policy; and sustainability. They have been developed through extensive consultation using forums, expert interviews, stakeholder workshops, discussion papers and broadcasting information through a webinar. For the first strategy in 2010, over 400 people attended roundtables and industry briefings, and Skills Australia received 45 written submissions.

The second phase involves economic modelling to draw out the skill implications of the various scenarios. The AWPA has commissioned a private consultancy to translate the scenarios into assumptions about key macroeconomic variables. A dynamic macro model of the Australian economy is used to forecast the balance between the demand and supply of qualifications under the different scenarios. The model estimates employment growth by occupation, replacement demand, and new job openings. Based on the current qualifications profile, it also projects skills deepening and skills broadening to forecast the implied demand for qualifications. The supply of qualifications has been modelled as additional qualifications resulting from domestic student qualification completions, considering current qualifications completion profiles

and demographic projections; it also includes the contribution to qualifications from net migration (Deloitte Access Economics, 2012). Detailed projections on both the demand and supply side have been produced across a range of occupations, industries, years, qualification levels and regions.

The third phase includes the development of additional information and analysis for each industry, based on the scenarios and the modelling. These industry snapshots include analysis of industry-specific data from sources like the Australian Bureau of Statistics and the Department of Education, Employment and Workplace Relations. They also use the 'environmental scans' and other information provided by the ISCs.

This approach seems effective in combining qualitative and quantitative intelligence from a broad range of sources, using sophisticated economic modelling and a rigorous analytical process.

A9.3.2. Industry skills councils

ISCs bring together industry, educators and governments to create a common industry-led agenda for skills and workforce development at the national level. Their key role is to represent industry in the management and planning of vocational education and training and in the development of training products, as well as providing advice to Australian, state and territory governments about industry skills needs.

The formal roles of ISCs include:

(a) collecting information on industry training needs from employers, unions and professional industry associations;

(b) providing industry intelligence and advice on current and future workforce development and skills needs to the AWPA, government and enterprises;

(c) supporting the development, implementation and continuous improvement of high-quality training and workforce development products and services;

(d) primary responsibility for the development and maintenance of training packages (competency standards);

(e) providing independent skills and training advice to enterprises, including matching identified training needs with appropriate training solutions;

(f) together with the AWPA, coordination of the national workforce development fund.

ISCs do not provide training or assessment services, or work with individual companies, but focus on strategies that serve the needs of the wider industry.

The network of ISCs was created in 2004 by significantly rationalising the former system of national industry training boards. A total of 11 ISCs have been established to align with the main areas of the real economy. They are independent, not-for-profit companies, governed by industry-led boards. They are bipartite in ownership and through the membership of their boards, but they are not required to have equal representation. ISCs are funded by the Australian Government through base and project funding. The amount of funding to each ISC varies in line with the number and size of sectors, enterprises, workforce and occupations it covers.

ISCs provide key labour market intelligence to the AWPA and other stakeholders through the annual 'environmental scans' of their respective industries. The information in these scans is unique, as it is based on real-time industry views and evidence from across Australia. A common feature of them is that ISCs use various surveys and consultation to collect information about the drivers of workforce development and the perceived effectiveness of Australia's training system. ISCs also use various methodologies to identify current and future skills needs in quantitative and qualitative terms, and to validate the information gathered from industry [87]. Some use high-quality macroeconomic models through contracted professional agencies [88]. Others rely more on in-house analysis of historical data and projections prepared by the Australian Bureau of Statistics, the Department of Education, Employment and Workplace Relations and other central agencies.

Besides providing intelligence about industry skill needs to stakeholders, environmental scans form the basis for developing training packages.

ISCs work as a network, mirroring the interrelationships between industries and the supply chain nature of the economy. From time to time, they also conduct joint work to provide consolidated, formal advice to government on specific issues that affect skill needs across sectors (ISC, 2009; 2011).
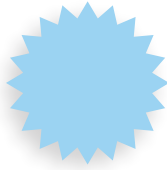
A9.3.3. State/territory industry training advisory boards (ITABs)

The Australian skills development framework operates across two-tiers of governance. State and territory governments have control over education policy, and encompass training authorities that administer vocational education and training in their jurisdictions. These agencies are responsible for allocating funds, registering training organisations and accrediting courses; they also have a key role in the development and endorsement of training packages. The state training authorities are accountable to their minister, who is a member of the Council of Australian Governments, standing council on tertiary education, skills and employment.

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[87] For example, see http://tlisc.org.au/wp-content/themes/tlisc/downloads/escan_flyer.pdf

[88] For example, Service skills Australia commissioned detailed *Labour and skills forecasts for the service industries*. http://www.serviceskills.com.au/labour-and-skills-forecasts

States and territories also have their own industry-led sectoral skills development networks ([89]). These are state-funded, with funding tied to the provision of services to support critical areas of TVET. Industry training advisory boards or councils are autonomous, industry-led bodies that aim to identify and prioritise their industry's skills and workforce development needs. Their general role is to ensure the availability of suitable training and skills development arrangements in vocational education and training. In addition to representing industry's skills needs and providing advice to stakeholders, ITABs assist in the development of training products, develop training and career information resources, promote the benefits and opportunities of vocational education and training to their industries, and provide support for training providers.

Similar to the environmental scan of the ISCs, most ITABs produce annual change drivers reports that provide qualitative and quantitative information on current and future skills needs in their sectors, and identify training solutions. Besides surveying industry to collect first-hand information, the reports use various methodologies and data sets to provide an analysis of and a broader context for industry skill needs.

The functions of ITABs significantly overlap with those of the ISCs. They seem better able to capture industry needs at state-regional level, while ISCs focus more on issues affecting the overall strategic development of their sectors and the national training system. ITABs often work together with their national industry skills council counterparts. For example, their intelligence feeds into discussions on training, skills and workforce development issues impacting the industry's growth in the national context. Areas of collaboration include attraction of people into the industry, particularly in terms of improving its image; building workforce capability and engagement; and improving the quality of training delivery in thin markets.

A9.4. Lessons learned

Australia has a well-developed and effective system of anticipation of future skills needs. It is based on a combination of qualitative and quantitative approaches. The sectoral doorway has been a key feature of vocational education and training generally, as well as in processes linked to future skill needs.

The main tool used for designing possible futures is scenarios development. Many actors, stakeholders and experts from industry, state training boards, the education and training sector, intermediaries and enterprises participate in this; such collaboration offers valuable insights into the future. The collaborative approach is one of the typical characteristics of the foresight exercise, as are consensus on shared visions and commitment to the results. The fact that administration of the process comes from the government guarantees that findings will be used to improve the education and training packages for the benefit of the future labour force.
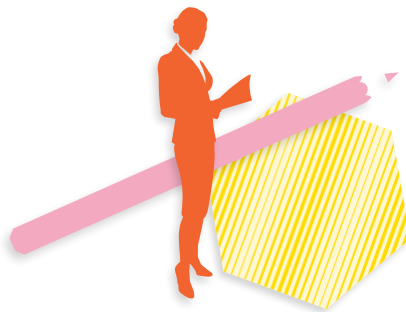
([89]) Various arrangements exist across the states and territories. The numbers of state-level ITABs are: ACT (2), Northern Territory (6), Western Australia (10), Tasmania (1+industry liaison officers), Victoria (used to have 16, they were abolished in 2012), Queensland (11), South Australia (9), New South Wales (11).
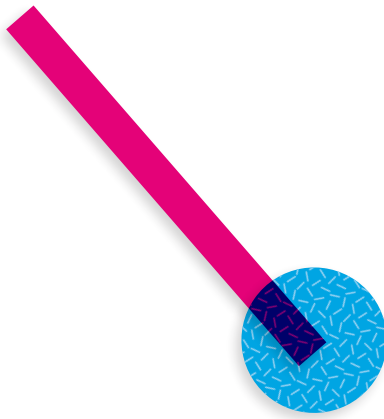
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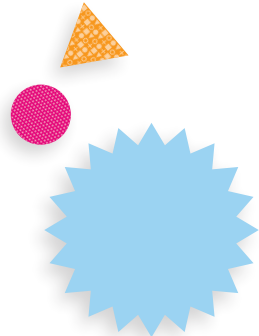
ACRONYMS

AWPA	Australian Workforce and Productivity Agency
ISC(s)	Industry skills council(s)
ITABs	Industry training advisory boards
TVET	technical and vocational education and training

ANNEX 10.
United Kingdom

A10.1. Economic and social context

In the early 1990s, the research and development in the United Kingdom (UK) that should reinforce technology infrastructure and business was losing its drive compared to many other countries. In response, the newly established minister for science founded an office of science and technology that began to work on developing national science and technology foresight activities and culture. In 1994 a technology foresight programme was commissioned. It initially concentrated on fostering a national foresight culture and closer interaction between scientists, industry and government, as well as pragmatic issues such as identifying science and technology development opportunities and exploring how these developments could address key future challenges. As the programme reached across the largest sectors of the UK economy and explored various social, environmental, economic and policy dimensions, it was soon renamed the UK foresight programme.

Progress was made towards creating a foresight culture; foresight activities gained considerable support at the government level and engaged the interest of participants. Government departments and agencies became the major sponsors of various foresight exercises.

Since 2008 the economic crisis has affected the economy of the UK along with most other developed countries. The competitiveness of the UK's workforce seems to be threatened as its skill levels are falling behind other countries (Spilsbury and Campbell, 2009; 2010). In 2008 a Commission for Employment and Skills was established to raise UK levels of prosperity and opportunity by improving employment and skills and by providing strategic information and guidance for the UK government and other stakeholders. Among other activities, the commission carried out a national strategic skills audit aiming to provide valuable insights into strategic skills needs; an audit for England and Wales has been carried out so far. As one of the research activities feeding into the audit, a foresight exercise was carried out to assess the future drivers,

challenges and opportunities for UK skills. The example examined is the national strategic skills audit for England and particularly the 2020 horizon scanning and scenario project that was a source of key foresight data for the audit.

A10.2. Main challenges and policy objectives

The main general objective of the national strategic skills audit was to provide information on the challenges and opportunities presented by, and underlying trends for the future development of the English workforce in relation to the country's strategic goals in this area. It should provide intelligence for the decisions of government, employers and education and training providers, as well as individuals.

The 2020 horizon scanning and scenario project used foresight methodologies (especially horizon scanning, interviews and scenario approaches) in support of its aims:

(a) to identify key issues (within the UK as well as worldwide) that may in the long term impact the UK employment sector and its skill requirements;

(b) to determine employment and skills drivers of change;

(c) to produce a working set of scenarios for the 2020 employment and skills landscape and use them to analyse the challenges and opportunities for government and employers.

A10.3. Key institutions, processes, approaches, methodologies and results

Among the key institutions involved was the UK Commission for Employment and Skills (UKCES), which was responsible for the process. The audit built on five separate research undertakings:

(a) an initial labour market information (LMI) assessment drawing on a wide range of source materials, predominantly based on quantitative data;

(b) 25 sector skills assessment reports produced by each of the sector skills councils (SSCs), based on a mix of national data supplemented by sectoral surveys, interviews and other information;

(c) six additional skills assessment reports focusing on emerging sectors produced by SSCs grouped into clusters;

(d) three additional skills assessment reports on three of the emerging sectors, produced for the UKCES by experts;

(e) a horizon scanning and scenario report provided by the St Andrews Management Institute (SAMI), based on foresight methods and identifying key issues and changes which may impact on employment and skills over the long term.

The scheme of the national strategic skills audit illustrates the position of horizon scanning among the other activities, as shown in Figure A13.

Figure A13.   Scheme of the national strategic skills audit
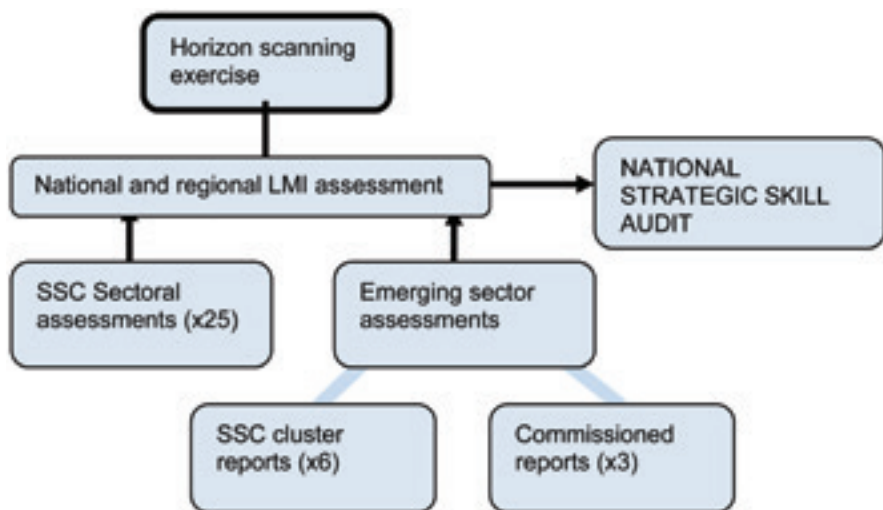
Source: UKCES (2010b).

A10.4. 2020 horizon scanning and scenario project

The UKCES commissioned the 2020 horizon scanning and scenario project from the SAMI, who also produced the report.
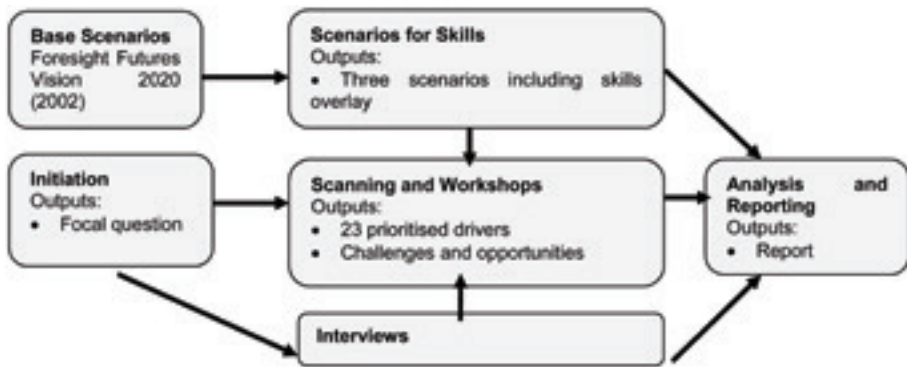
In its initial phase, the project's 'focal question' was formulated: 'What will be the drivers and impact of change on the employment and skills landscape in England by 2020; what are the challenges and opportunities for government and employers?' The basic project outline consisted of:

(a) identification of key issues and changes that have (in the long term) the potential to influence UK employment and skills;

(b) identification of the main employment and skill drivers;

(c) overlaying existing economic and social scenarios for 2020 (the scenarios developed within the foresight futures vision project (2002) 'foresight 2020' [90] were used) with the identified skills drivers resulting in a working set of scenarios for the employment and skills landscape;

(d) analysis of the challenges and opportunities for government skills policy in relation to the developed scenarios;

(e) drafting a report to contribute to the national strategic skills audit 2010.

Several interlinked methods were used to fulfil these objectives.

Figure A14. The scheme of the project methods/activities

Source: Duckworth et al. (2010).

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[90] The scenarios were developed for the then Department of Trade and Industry by a team from the University of Sussex (SPRU-Science and Technology Policy Research). Various experts from business, government and academia were involved in the scenario development, and an extensive review of national and global future scenarios were devised. The results have been widely used in the UK.
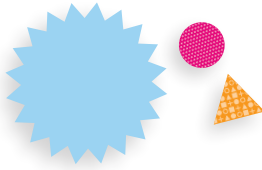
A10.4.1. Interviews

Some 21 interviews were conducted, with a main focus on the key question of the project: 'What will be the drivers and impact of change on the employment and skills landscape in England by 2020; what are the challenges and opportunities for government and employers?'

Among the experts interviewed were senior members of the UKCES, other stakeholders cooperating with the Commission, and experts in economics, technology and society; their names were not published to maintain the strictly non-attributable character of the exercise. The main goal was to select key areas for further research: the results were added to scanning data and were used to prepare the skills overlay for the scenarios as well as for the optimistic and pessimistic scenarios for skills in 2020.

A10.4.2. Horizon scanning
A10.4.2.1. *General scanning*

The purpose of the horizon scan was to identify the trends and drivers that may potentially affect the UK's long-term employment and skills landscape and future skills needs.

A comprehensive scan of global and national key factors was based on various published information sources. The factors examined were drawn principally from the four PEST areas (political, economic, social and technological factors) but also included legal, regulatory and environmental factors.

Issues were considered in terms of potential impact up to the project horizon of 2020, and also beyond (over the next 25 years), to stretch the thinking about the future and also to provide useful material for eventual next development of the scenarios' time lines. The activity produced 101 selected trends.

A10.4.2.2. *Prioritisation*

The suggested 101 trends were reviewed in a project team workshop. They were sorted first according to the probability that they would be important to the world in general and then for impact on the UK skills landscape, and grouped into interrelated clusters. A four quadrant chart was created, based on these two dimensions. The trends with both low estimated importance for the world and also low impact for UK skills were excluded from further analyses. This resulted in 23 trends and drivers identified as the most important factors of future development.

A10.4.3. Scenarios
A10.4.3.1. *Selecting base scenarios*

Existing scenarios for future development, created in the framework of the foresight futures vision 2020 project, were chosen as a base for the next process. They were built on analysis of socioeconomic trends, taking into account possible new developments and changes. Two key dimensions were considered: orientation of social values (from an individual approach at one extreme to community-oriented values at the other); and autonomy of the national government, from decision-making staying firmly with national or regional governments at one extreme to decision-making shifted more to supranational bodies – for example, the European Union or multinational corporations – at the other. From the original four scenarios (based on four quadrants resulting from the two dimensions), three were selected that were considered to have greater impact on employment and skills in the UK. They were then further elaborated to reflect the global developments since the time when the original scenarios were created and to take into account potential recovery paths following the economic crisis. The scenarios are:

(a) world markets: high individual aspirations and independence in a global economy sustained by international cooperation, internationally coordinated policy ensures efficiency of markets, minimal government, emphasis on the rights of individuals and high growth;

(b) national enterprise: both individuals and governments seek autonomy and independence;

personal independence and material wealth within a nationally-rooted cultural identity, liberalised national markets, aspirations towards a high degree of national self-reliance and security, minimal international cooperation and a more fragmented medium–low growth;

(c) global sustainability: a caring world where individuals value the community and government implements policies for welfare and sustainability; aspirations towards high levels of welfare within communities, more equally distributed opportunities, emphasis on active public policy and international cooperation, competition within a regulated framework and medium–high growth.

A10.4.3.2. *Skills overlay to the base scenarios*

This step sought to develop the general scenarios to reflect the employment and skills dimensions and developments represented by the drivers identified during the scanning process. Each of the selected drivers was assessed against each of the scenarios, with its relevance, likelihood and impact (on or within the scenario) being estimated. The drivers that represented probable trends over the next 10 years were overlaid with all three scenarios, while drivers that appeared rather uncertain were assigned to the scenarios in different degrees. Finally, the consistency, plausibility and accuracy of the scenarios were assessed.

Although the broad scope of the research made it impossible to examine in detail the implications of each single driver against each scenario, or draw out the interdependencies between drivers, the exercise

provided valuable relevant insight into the possible futures in terms of employment and skills.

A10.4.3.3. *Scenario workshop*

The variants of scenarios with the analysis of the implications of each of the key drivers were reviewed at a workshop of SAMI team members, UKCES members and other relevant experts. The experts were allocated to three groups according to the three base scenarios. Their task was to assess the impact of the scenarios on the UK employment and skills landscape and to derive a basic view of the challenges and opportunities for the government and employers.

A10.4.4. Scenario 'wind tunnelling'

In the final stage of the project, the technique called 'wind-tunnelling' was used. Its purpose is to test current policies and strategies by exploring their possible impact in the different futures. The three scenarios were compared with the existing relevant policies and the future policy options. The process produced an outline of the implications for government strategy for future skills, and suggested potential challenges and opportunities.

## A10.5. Lessons learned

The 2020 horizon scanning and scenario project identified the sectors, occupations and skills that should be of special attention in meeting the new challenges and developments of the economy and labour market. The resulting final report was intended to stimulate wider debate and appropriate action among all stakeholders involved in shaping a successful future for the UK.
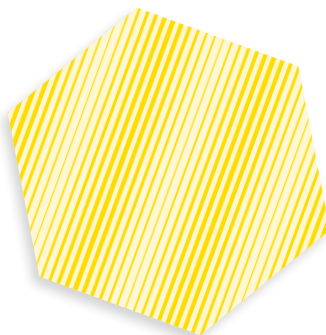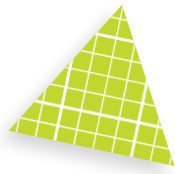
It was one of the main inputs for the national strategic skills audit. Through the work of the UKCES, the intelligence gathered serves the UK government, employers, training providers and individuals as background information for their decisions. Various implications and recommendations have resulted for the continuation of the national strategic skills audit research programme in relation to foresight activities:

(a) the 'wind tunnelling' technique can be used for testing further policies and strategies relevant to skills;

(b) the horizon scanning activity should be extended to a 20-year scope in the next national strategic skills audit. As education is necessarily a long-term investment, and technologies under rapid development will probably have significant impact after 2020, the time horizon of 2030 seems appropriate for the next exercise;

(c) an appropriate scenario framework is a key issue. It can help to inform strategic evaluation and implementation of policies, make them more robust against a range of possible futures, and reduce the level of risk. Complex interactions between technology and society mean that the 2020 scenarios cannot be simply extended over a longer period. A scenario framework that includes these additional factors, such as the ethnographic futures framework, is recommended for the 2030 foresight horizon. The ethnographic futures framework is an approach that tries to characterise the future by addressing several broad aspects:

(i) define: the social values, culture, economic systems, politics and public policy which shape the world around us;

(ii) relate: the social and organisational structures which link people, influenced by demographics, lifestyles, work and the economy, the environment, business models, government and education;

(iii) connect: the technologies used to connect people, places and things, including information technology, the media, language and planning;

(iv) create: how goods and services are produced, including manufacturing, energy generation, life sciences, material sciences;

(v) consume: how we acquire and use goods and services, such as consumer goods, energy, food and agriculture, housing, healthcare, natural resources and the environment;

(d) a deeper and more extensive technology scan is needed within the next skills audit exercise. The 2020 horizon scanning and scenario project concentrated on current technology trends, the impact of which up to 2020 is more or less predictable. The UK will also need an appropriately skilled workforce for new technologies currently in development, if it intends to be at the heart of these developments;

(e) the addition of geopolitical factors, such as China potentially becoming the world's largest economy, is recommended for future research.
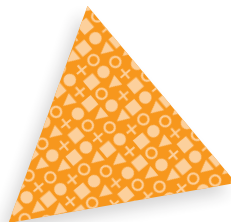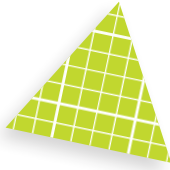
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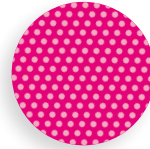
ACRONYMS

LMI	labour market information
SAMI	St Andrews Management Institute
SSCs	sector skills councils
UKCES	UK Commission for Employment and Skills s

ANNEX 11.
United States of America

A11.1.   Economic and social context

The United States (US) economy is the world's largest, with about USD 15 trillion gross domestic product (GDP) (purchasing power parity (PPP)) and a population of 312 million. The US has still not recovered fully from the 2008 financial crisis and ensuing recession.

The US is one of the leading countries in occupational and skill needs anticipation in the world. Considerable efforts and resources are devoted to the composition of supply and demand for skilled labour and on limiting the extent of skill shortages within the economy. Skills forecasts are actively used not only by government officials but also career counsellors, enterprises and individuals.

There are many (sometimes competing) forward-looking activities to identify trends, future opportunities and funding priorities in science and technology, developed by different institutions in various fields. The project Future work skills 2020, sponsored by the University of Phoenix in 2011, has been chosen as an example of foresight used for anticipation of future skill needs. The activity resulted in recommendations relevant for skills development in areas of education, business and government.

A11.2.   Main challenges and policy objectives

The research institute of the University of Phoenix pursues academic research on working learners, higher education and industry with the aim of improving educational outcomes and promoting a better prepared workforce. In 2011 it commissioned research to increase understanding of the skills workers will need over the next decade in a technologically advanced and changing world. The resulting report, Future work skills 2020 (authored by the Institute for the Future) analyses the key drivers that will reshape the landscape of work, and identifies the most crucial work skills that will be needed in the next 10 years. It does not seek to determine what the jobs of the future will be, but to identify the proficiencies and abilities required across different jobs and work settings.

A11.3.   Key institutions, processes, approaches, methodologies and results

The University of Phoenix Research Institute sponsored the research exercise by the Californian foresight organisation Institute for the Future (IFTF), an independent, non-profit, strategic research group that has pioneered foresight tools and methods for more than 40 years.

The research methodology was based on the following components.

A11.3.1.   Drawing on existing foresights

During the work, the IFTF drew on its previous forecasts in areas as diverse as education, technology, demographics, work, and health, and their annual 10-year forecast. The 10-year forecast is based on IFTF's 'signals methodology', which builds on aggregating data, expert opinion and trends research to understand patterns of change. A signal is understood as a typically small or local innovation or disruption that has the potential to grow in scale and geographic reach. It can be a new product, a new practice, a new market strategy, a new policy, or new technology that points to larger, perhaps global, implications. Signals tend to capture emergent phenomena sooner than traditional social science methods, so are very useful in anticipating highly uncertain futures.

Signals differ from trends as they can point to possible innovations before they become obvious. They also differ from indicators because they often cover marginal, but potentially game-changing, phenomena rather than mainstream developments. Though local trends and indicators can function as signals when they reach a certain threshold, they may indicate a change spreading to the larger population.

A11.3.2.   Expert workshop brainstorming

The research was complemented by the expert workshop held at the IFTF's headquarters. Experts in a diverse range of disciplines and from various professional backgrounds were brought together. They

were engaged in brainstorming exercises to identify key drivers of change and how these will shape future skill requirements.

A11.3.3.   Analysis and filtering of collected data

In the final stage, all of the information gathered was analysed and filtered. Six key drivers and 10 skills areas that will be most relevant to the future workforce were identified.

A11.4.   Lessons learned

The research outlined the basic challenges that the future workforce will face in the form of general skill requirements on the labour market, but also in society as a whole. Individuals will have to navigate paths through the rapidly changing landscape of organisational forms and skill requirements, continually reassessing, developing and updating their skills. High adaptation capabilities, flexibility and life-long learning will be necessary to succeed.

The results of the exercise are summarised in Figure A15.

Figure A15.   Six drivers and 10 skills needed in the future

Source: IFTF (2011).
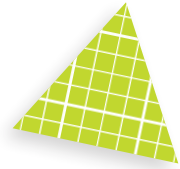
The results have implications for individuals, education institutions, business and government. The authors of the study suggest several directions for each of the stakeholder groups to take in tackling the challenges of future development:

(a) for education institutions:

  (i)   to support developing skills such as critical thinking, insight and analysis capabilities;
  (ii) to integrate new-media literacy into education programmes;
  (iii) to include experiential learning that emphasises soft skills (for example, the ability to collaborate, work in groups, read social cues, and respond adaptively);
  (iv) to target their provision not only to youth, but also to adults;
  (v)   to integrate interdisciplinary training that allows students to develop skills and knowledge in several subjects.

(b) for enterprises:

  (i)   to adapt their workforce strategies to respond to future skill requirements;
  (ii) to reconsider traditional methods for identifying critical skills, as well as selecting and developing talent;
  (iii) to take into account the disruptions likely to reshape the future, so it is possible continuously to reshape the company skills and talents pool for the sustainability of business goals;
  (iv) to collaborate with universities to address lifelong learning and skill requirements.

(c) for government policy-makers:

  (i)   to make education a national priority to ensure a country's ability to prepare people for a sustainable future;
  (ii) to consider the full range of skills citizens will require, as well as the importance of lifelong learning and constant skill renewal.

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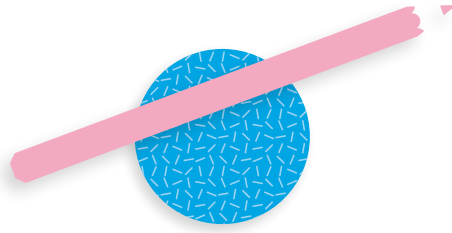
Website

[URL accessed 29.5.2014]

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KEY TECHNICAL TERMS

Anticipation	Denotes various qualitative and quantitative methods aimed at identifying future skill needs.
Apprenticeships	Systematic, long-term training, alternating periods at the workplace and in an educational institution or training centre. The apprentice is contractually linked to the employer and receives remuneration (a wage or allowance).The employer assumes responsibility for providing the trainee with training leading to a specific occupation (Cedefop).
Backcasting	Normative method that is used in complex situations where a desirable future is defined and agreed, and then the method works backwards and identifies several actions needed to achieve a desirable output.
Cluster	A cluster is understood as a network of suppliers, producers, customers and competitors connecting between themselves and with institutions of knowledge production and diffusion to build new competitive factors and new competencies and to increase added value.
Competency	The proven or demonstrated individual capacity to use know-how, skills, qualifications or knowledge in order to meet usual and changing occupation situations and requirements (UNESCO).
Delphi method	This is an expert survey implemented in two or more rounds, where in the second and later rounds of the survey, the results of the previous round are provided as feedback.
Employment service provider	Public and private employment services whose main task is to aid job matching. (See Volume 4.)
European Qualification Framework (EQF)	Reference tool for describing and comparing frameworks for lifelong qualification levels, developed at national, international or sectoral levels (Cedefop).
Exploratory method	Future research that attempts to identify multiple possible future settings. It starts with the preconditions, beliefs and social or technological possibilities which already exist.
Forecasting	Quantitative forecasts are statistical projections, econometric models or similar methods that produce information on aspects of future labour markets (supply and demand, skills, qualifications, etc.). Forecasts use data about the present and past to estimate future developments.
Foresight studies	Foresight studies are typically multi-disciplinary, mostly qualitative approaches based on interviews, discussions, focus groups and Delphi methods, to analyse present and future developments. The key feature of foresights is their action orientation.
Horizon scanning	A systematic examination of opportunities and likely future developments which are at the margins of current thinking and planning. Horizon scanning explores novel and unexpected issues, as well as persistent problems and trends (OECD).
Job	A set of tasks and duties performed, or meant to be performed, by one person, including for an employer or in self-employment (ILO, 2012).
Labour market information	Any information concerning the condition, functioning and problems of the labour market. The information includes opportunities which may be available to it, and the employment-related intentions or aspirations of those who are part of it. (See Volume 1.)
Labour market information system (LMIS)	A labour market information system consists of a set of institutional arrangements, procedures and mechanisms that are designed to produce labour market information (ILO, 1997). (See Volume 1).
Matching	Matching denotes approaches and actions that aim to increase the employability of the workforce and reduce skills shortages, including filling jobs with qualified jobseekers. This term is broader than job referral or placement.

Mismatch	Mismatch refers to situations where a person's skillset does not meet the job requirements and where there is a shortage or surplus of persons with a specific skill. It includes different types of skill gaps and imbalances such as over-education, under-education, over-qualification, under-qualification, over-skilling, skills shortages and surpluses, skills obsolescence, and so forth. Skills mismatch can be identified at the individual, employer, sector or economy level.
Normative methods	Future research that attempts to identify desirable future settings and works backwards to see if and how this future might be achieved, or avoided, given existing constraints.
Occupation	An occupation is defined as a set of jobs whose main tasks and duties are characterised by a high degree of similarity. A person may be associated with an occupation through the main job currently held, a second job or a job previously held (ILO, 2012).
Public Employment Service (PES)	Public Employment Services provide job search assistance and placement services. They analyse and disseminate labour market information, and develop and implement targeted labour market programmes and services (ILO, 2009). (See Volume 4.)
Qualification	A formal expression of the vocational or professional abilities of a worker which is recognised at international, national or sectoral levels (ILO). An official record (certificate, diploma) of achievement which recognises successful completion of education or training, or satisfactory performance in a test or examination.
Roadmapping	A normative method that aims to look at the future for a chosen field and to identify the most important drivers of change in that field (JRC-IPTS). It provides inputs for the formulation of policies and strategies (UNIDO).
Skill	Skill is understood as being the ability to carry out a mental or manual activity, acquired through learning and practice, where skill is an overarching term which includes knowledge, competency and experience, as well as the ability to apply these in order to complete tasks and solve work-related problems.
Skill gap	Used as a qualitative term to describe a situation in which the level of skills of the employee or a group of employees is lower than that required to perform the job adequately, or the type of skill does not match the job requirements (Cedefop, 2010).
Skills shortage	Used in this guide as a quantitative term to describe a situation in which certain skills are in short supply, for example where the number of jobseekers with certain skills is insufficient to fill all available job vacancies.
Swot analysis	Analytical tool which helps to identify main internal (strengths and weaknesses) and external (opportunities and threats) factors that may shape the reality of a given situation (now or in the future).

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This guide is a part of the ETF, ILO and Cedefop series of guides on skills anticipation and matching. All the guides follow a common structure, although they vary in terms of level of detail, technical content and case studies. All guides have gone through extensive validation and peer review; they were also discussed in detail in international expert seminars in which academic representatives, anticipation and matching experts, and potential end-users from all over the world provided comments and feedback on content and usability. Experts and staff of the three organisations also peer reviewed the guides before their publication.

This volume covers the development of skills foresights, scenarios and skills forecasts, and aims to support setting up skills forecasting systems at national level by means of quantitative and/or qualitative approaches. The guide is built on a number of experiences and case studies in both developed and developing countries. It proposes a set of instruments devised to help guide new initiatives in this area. Adapted to specific objectives and country contexts, elements of the methods described can be combined.

The guide is intended specifically for countries which are starting to develop systems of skill needs anticipation. It provides information for sponsors and implementers of skill needs anticipation initiatives, such as policy-makers, education and training providers, public employment services, social partners and research and specialist organisations.