



Investing in the Future of Jobs and Skills

Scenarios, implications and options in anticipation of future skills and knowledge needs

Executive Summary Telecommunications



Authors:

Dr E. Dijkgraaf (ed.) (SEOR Erasmus University)
Dr F. van der Zee (ed.) (TNO Innovation and Environment)
Dr G. Gijsbers (TNO Innovation Policy Group)
M. de Jong (SEOR Erasmus University)
W. Jonkhoff (TNO Innovation and Environment)
A. Dieke (WIK-Consult)
S. de Munck (TNO ICT Innovation Management)
D. Maier (ZSI Centre for Social Innovation)



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Executed by:

TNO Netherlands Organisation for Applied Scientific Research
SEOR Erasmus University Rotterdam
ZSI Centre for Social Innovation

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Overview

This executive summary highlights the main results of the final report *Investing in the Future of Jobs and Skills. Scenarios, implications and options in anticipation of future skills and knowledge needs in the Post and Telecommunications Sector*. It specifically addresses the Telecoms Sector. Apart from analysing sector trends and developments, the study explores four plausible and distinctly different futures and their implications for jobs, skills and knowledge in the year 2020. The study is scenario-based, and is both forward- and backward-looking. It presents a variety of options and recommendations to address future skills and knowledge needs, aimed at the sector (firms, industry at large, sectoral partners), education and training institutes, policy-makers and other stakeholders.

The study should be placed against the background of the EU's renewed Lisbon Strategy for Growth and Jobs and the recently launched New Skills for New Jobs initiative. Investing in people and modernising labour markets is one of the four priority areas of the Lisbon Strategy. The New Skills for New Jobs initiative (European Commission, 2008; see <http://ec.europa.eu/social/>) presents a very first assessment of the EU's future skills and jobs requirements up to 2020. The initiative aims to help ensure a better match between the supply of skills and labour market demand and to improve the Member States' capacity to assess and anticipate the skills needs of its citizens and companies.

This study appears in a series of 16 sector studies which are all based on the same common foresight methodology and uniform step-wise approach (see Table). The study combines desk research and expert knowledge, and brought together various internal (project team) and external sector experts. The methodological framework that was initially developed by Rodrigues (2007) was further developed, operationalised and applied by a consortium consisting of TNO (lead), SEOR and ZSI.

Methodological framework – the study explained in ten steps

- Step 1. Identification of economic activities (sector selection)
- Step 2. Main economic and employment trends and structures
- Step 3. Main drivers of change
- Step 4. Main scenarios
- Step 5. Main implications for employment – changes by job function
- Step 6. Main implications for skills – emerging needs by job function
- Step 7. Main strategic choices to meet future skills and knowledge needs
- Step 8. Main implications for education and training
- Step 9. Main recommendations
- Step 10. Final workshop (validating, complementing, finalising)

The telecommunications sector – main characterisation

The telecommunications sector provides telecommunications and related service activities like transmitting voice, data, text, sound and video, either wired or wireless. The sector is characterised by rapid development in terms of business structure ('old' incumbents facing new competitors) and new demand and supply, with new technologies (mobile and handheld devices Internet, computers, optic fibre networks), trade liberalisation, deregulation and privatisation being important drivers. Convergence is a key word in telecoms, not only in technologies, but also in the blurring of boundaries between telecoms and other

communication media including electronic and broadcast media. Broadcasting, voice telephony and on-line computer services used to be operated on different platforms, by different business support systems and to serve different markets. Different media each used to be regulated differently by different regulators. Not anymore. Not only do new companies such as eBay, Yahoo, Google and Skype compete directly with incumbent telecoms providers. But also telcos do no longer confine themselves to their 'own' traditional markets anymore, and do actively enter other new business domains such as communication, advertising, and (new) media.

Main economic and employment trends

Value added of the sector as a whole amounted to €190.3 bn in 2005, of which €136.2 bn was generated in the big five. These are in order of size: the UK, Germany, France, Italy and Spain. Overall revenues amounted to €421.2 bn in 2005, of which an estimated €264 bn was produced by public telcos. In terms of turnover, the period 2000-2006 is characterised by uninterrupted growth (from 100 to 145 in index terms), with very strong growth in the beginning of the period, slowing down in 2005-2006 already and obviously further in the current crisis. However, most recent information indicates that overall revenue growth in telecoms in 2008 still amounted to 1.3%. Overall mobile operators seem to be better placed than fixed operators to weather the economic storm, due to greater flexibility in cost structure, capital expenditure (capex) and fixed-mobile substitution taking place more rapidly.

Employment, state-of-play 2006 and changes 2000-2006

Telecommunications	Level 2006 (in 1000)	Annual growth (in %)	Share in EU (in %)	Change in share (in % points)
EU	1 230	0.3	100	0
EU 15	1 071	0.7	87	2
NMS	159	-2.5	13	-2

Source: Eurostat/TNO. Telecommunications: NACE 46.2.

Altogether the sector accounted for about 29,000 enterprises (figures 2005), employing 1.2 million people or 0.6% of overall EU employment. New Member States (NMS) accounted for almost 13% of EU sector employment. On average employment growth figures are low and almost down to zero in telecoms, with only a few exceptions at the Member State level. A large difference concerns the new Member States, where employment has been decreasing strongly.

The majority (97.2%) of firms in the telecoms and post sector together (!) are small firms employing less than 50 employees. 1.9% are medium-sized firms and only 0.9% are large firms with more than 250 employees. However, small firms and medium-sized firm only account for 7.7%, respectively 4.8% of all employment; their share has been increasing with 2.5 and 2.3% points during the period 1995-2006. Large firms account for 87.5% of employment, with a decreasing share.

Telecoms is a sector characterised by strong growth and a product portfolio with an increasing share of new mostly ICT-based services, which obviously affects the skills mix. Most jobs are in the categories 'clerks' consisting of administrative and sales personnel, other professionals (most importantly sales & marketing professionals), engineers and IT professionals and technicians (mechanics and plant operators, see Table). Striking is the large share of clerks in the NMS compared to the EU-15. The share of women in overall

employment in post and telecoms combined is 36% for the EU-15, yet 53% for the NMS. Employment is dominated by medium educated employees; this is true for the EU-15 (52%), but especially for the new Member States (71%). Low educated workers, with a share of 25% in the EU-15 and only 4% in the new Member States, lost ground overall. Most of the low-educated, however, work in the post sector rather than in telecoms where most low-educated jobs have already disappeared during the last decade. Almost half of all employees is younger than 40 years, with a clear split between old incumbent telcos and new recently established companies.

Striking changes in the skills mix during the period 2000-2006 are observed in sales & marketing professionals (decreasing in EU-15 and increasing in NMS), technicians (increasing in EU-15, strong decrease in NMS) and engineers and IT professionals (an gradual upward change for the EU as a whole). The shift in skills structure reflects, amongst others, a change in technologies (fixed to mobile; analogue to digital; copper to fibre), markets (IT-based services rather than telephony) and business models (competition from ICT and new media companies).

Employment trends by job function: shares (2006) and changes in shares (in%), 2000-2006						
Post and Telecommunications	Shares, 2006		Changes in shares, 2000-2006			
	EU15	NMS	EU	EU15	NMS	EU
Managers	9	9	9	-2	1	-2
Engineers & IT professionals	8	9	8	1	4	1
Other professionals	17	18	17	-8	4	-6
Clerks	40	47	41	1	2	1
Service workers	2	3	2	-2	-4	-2
Electronic equipment mechanics	5	5	5	2	-5	1
Craft workers. Plant operators. Drivers	7	5	7	7	-3	6
Elementary occupations*	12	4	11	1	2	1

Source: Based on Eurostat Labour Force Survey/TNO. * Mostly related to post: sorting staff and mail carriers.

Employment by gender, age and education: post and telecoms, 2000-2006						
	EU		EU 15		NMS	
	Level	Change	Level	Change	Level	Change
Women	39	1	36	0	53	-4
Age < 40	48	-4	48	-4	54	3
Age 40 – 50	30	0	30	0	27	-4
Age > 50	22	4	22	4	19	1
Low education	21	-4	25	-2	4	-4
Mid education	57	2	52	-1	71	-5
High education	22	2	23	3	25	9
Entrepreneurs	3	n.a.	2	n.a.	4	n.a.
Definition	Level %	Total change %	Level %	Total change %	Level %	Total change %
	2006	2000-2006	2006	2000-2006	2006	2000-2006

Source: TNO/Alphametrics based on Eurostat Labour Force Survey

SWOT analysis and Main Drivers of Change

The Strengths-Weaknesses-Opportunities-Threats (SWOT) analysis and the expert-based search for main drivers of change (see Tables) both yield important building bricks for the design and further elaboration of the scenarios. In constructing the scenarios a further differentiation was made between exogenous drivers (drivers that form a “given” at sector level)¹ and endogenous drivers (drivers that can be influenced at the sector level, for instance by national or European policy-making, or by collective effort from within the sector).

SWOT analysis Telecommunications	
Strengths	Weaknesses
<ul style="list-style-type: none"> ○ Increasing demand overall ○ New companies act as initiators ○ Dense network ○ New IT technologies ○ Diversification of job profiles ○ Trusted brands 	<ul style="list-style-type: none"> ○ ‘Old’ culture incumbents – civil service rather than business culture ○ Lack of separation between powers of government as incumbent-owner and as regulator in certain Member States ○ Oligopoly (potent players drive the sector)
Opportunities	Threats
<ul style="list-style-type: none"> ○ Liberalisation ○ Privatisation ○ Deregulation (transparent, long term and foreseeable) ○ Technology: IT-based, fibre, wireless, mobile ○ New products and services – based on virtual communication and digitalization (counteracting the shrinking demand for traditional services both in post and telecoms) and diversification ○ Convergence telecoms, communications, advertising and new media ○ Growth new EU Member States and global growth, driven by income and lifestyle ○ New forms of cooperation (public/private and private/private; open innovation) ○ High skilled job opportunities, need for up-skilling ○ Adaptation to new needs 	<ul style="list-style-type: none"> ○ Network capacity vs increasing future demand ○ Competition from ICT and new media in product and labour markets ○ Relocation of enterprises (long-term) and outsourcing of services) ○ Increasing regulation

Source: TNO/SEOR.

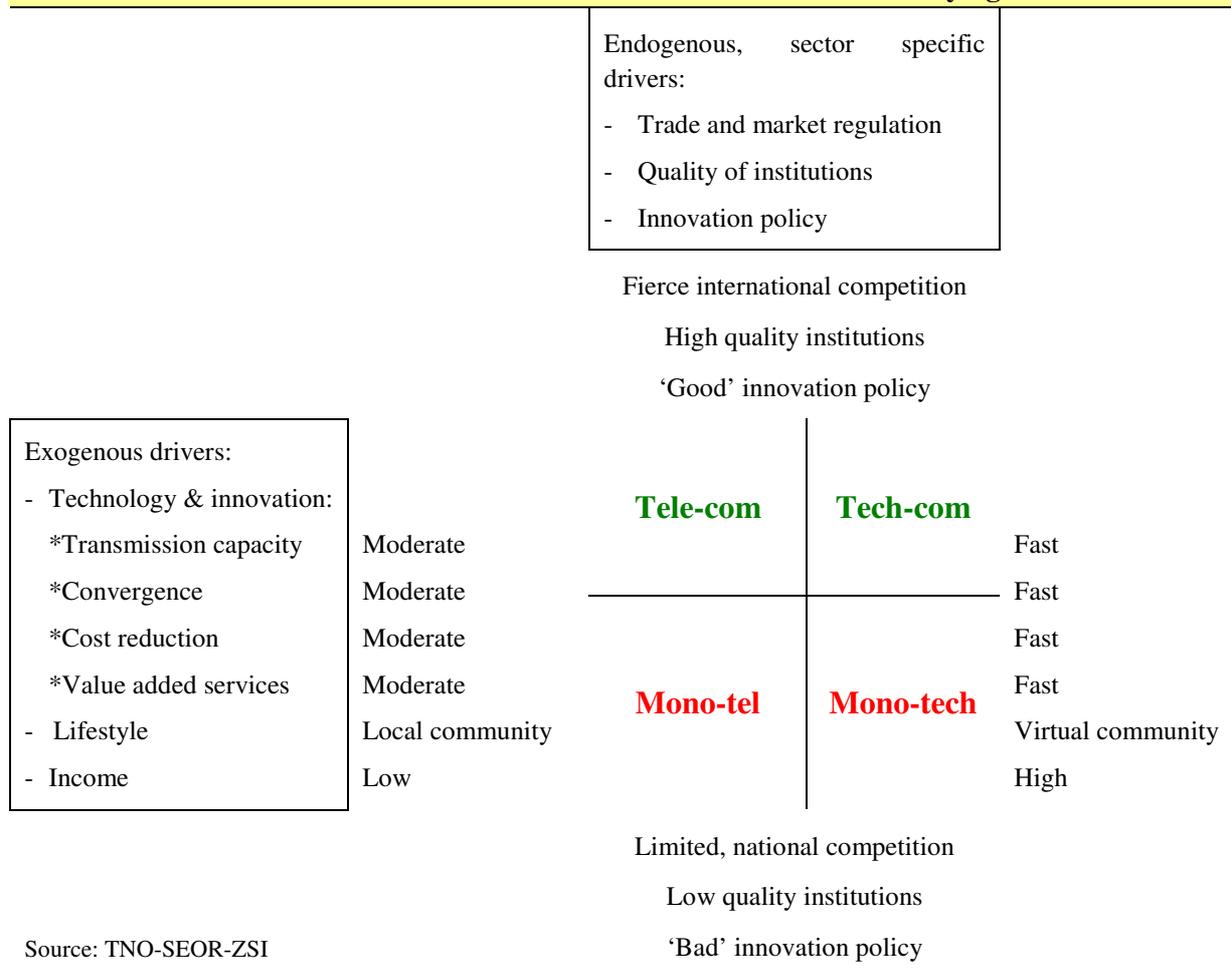
¹ With the exception here of Technology & Innovation, parts of which which can be influenced at firm level. For reasons of internal consistency of the scenarios, this driver is nevertheless categorised as exogenous.

Main drivers of change: Telecommunications sector											Source: ©TNO-SEOR-ZSI.	
Category	Driver	Is this driver relevant for the sector?	How relevant is this driver for the sector?	How uncertain is this driver for the sector?	Are substantial impacts expected on the volume of employment? Y/N	Are substantial impact expected on employment composition? Y/N	Are substantial impacts expected on new skills? Y/N	Short, medium or long run impact?			Substantial differences expected between (groups of) countries? Y / N	Substantial differences expected between subsectors? Y / N
		Y / N	Scale 0-10	Scale 0-10				S	M	L		
Economic	Income per capita and household	Y	10	5	Y	N	N	Y	Y	Y	Y	N
	Increasing global competition	Y	6	3	Y	N	N	Y	Y	Y	N	Y
	Emerging economies driving global growth (new market demand, especially BRICs)	Y	5	3	N	N	Y	N	N	Y	N	N
	Lifestyle changes	Y	10	2	N	N	Y	Y	Y	Y	N	N
Technology, R&D and product and process innovation	Advances in IT impacting on organizational structures & new business models	Y	5	6	N	N	Y	N	Y	Y	N	N
	Internet changing production and consumption patterns (e-business; etc.)	Y	10	0	Y	Y	Y	Y	Y	Y	N	N
	New types of work organization (teams-based, sociotechnique, etc.)	Y	5	0	N	Y	Y	Y	Y	Y	Y	N
	New/additional value-added services	Y	10	0	Y	Y	Y	Y	Y	Y	N	N
Institutional / Political	Trade and market liberalisation (national level)	Y	10	0	Y	Y	Y	Y	Y	Y	Y	N
	EU integration – broadening (bigger domestic market)	Y	5	5	Y	Y	Y	N	N	Y	Y	N
	Quality of institutions (judiciary, transparency, corruption, business climate, structural rigidities)	Y	10	0	Y	N	N	Y	Y	Y	Y	Y
	Labour market regulation	Y	3	3	Y	N	N	Y	Y	Y	N	N
	Security and safety regulation	Y	7	5	N	N	Y	Y	Y	Y	N	N

Scenarios and implications for employment

Four future scenarios have been constructed and explored: 1) *Mono-tel*, 2) *Tele-com*, 3) *Mono-tech*, and 4), *Tech-com* (see also Figure). The scenarios depict plausible and credible futures for the telecoms sector in Europe by 2020. Rather than wishful pictures (‘dreams’, ‘crystal ball gazing’) of the future, scenarios are founded on drivers and trends observed and are derived in a logical and deductive way, hence making inferences about plausible future developments. Rather than predictions or forecasts based on a model, the scenarios outcomes in this study are based on expert opinion. The bandwidth between the most extreme scenarios can be interpreted as indicative for the degree of uncertainty indicating possible paths for flexible anticipation.

Four future scenarios for the telecommunications sector and main underlying drivers



Construction, hypotheses and use of the scenarios

In constructing the scenarios, those drivers have been selected that scored high on the criteria relevance, impact and uncertainty. The relevance criterion was used to focus and tailor the scenarios to the aim at hand, i.e. drawing inferences on the future of jobs and skills and knowledge needs by 2020. Impact and uncertainty were used to define distinct directions in the four scenarios which have been depicted in the figure below, with the exogenous drivers on the horizontal axis and the endogenous drivers on the vertical axis. Note that demographics – ageing (less young, more retirees) – and its effects on labour supply have not explicitly been identified in selecting the drivers, as demographics in the time frame of 2009-2020 are relatively certain (i.e. predictable) and play a role across all scenarios. Education

and training, which *stricto sensu* could be perceived as endogenous factors, have been excluded. They form - together with a number of other strategies and/or policies - the solutions and hence a possible response to the impact of the scenario on skills, knowledge and jobs. The key features of the four scenarios can be described as follows:

Scenario I: *Mono-tel*

Mono-tel depicts a world characterised by limited technological progress, low income growth and a moderate degree of innovation. The demand for virtual social interaction is limited. Work, shopping, social life and leisure still take place in the ‘real’ rather than in virtual space. Personal face-to-face contacts remain an essential feature of social interaction; virtual contacts are seen as a supplement. Competition is limited, with high prices and the incumbent(s) still playing a dominant role. International players have problems in entering local (national) markets.

Scenario II: *Tele-com*

Tele-com depicts a world characterised by liberalization and deregulation, with fierce international competition. Large players compete within the EU area; telcos from emerging economies (e.g. China) try to actively penetrate the attractive EU single market. Prices continue to fall and service volumes increase, yet with slow income growth and slow adoption of new products and technologies. Personal contacts remain an essential feature of social interaction.

Scenario III: *Mono-tech*

Mono-tech depicts a world characterised by fast technological progress and innovation, with virtual contacts and dependence on IT networks becoming even more important: in work, in leisure, in shopping and in maintaining social contacts. Virtual contacts are seen as a substitute for ‘local’ face-to-face contact. Regulation fails to keep pace with technological change and restricts EU-wide competition. Concentration and limited competition leads to high prices; income growth is high and enables consumers to pay high prices. In the long run, ill-defined innovation policies and limited competition lead to a relative slowdown of technological progress.

Scenario IV: *Tech-com*

Tech-com depicts a world characterised by fast technological progress and innovation, with the virtual community taking over from the local community. High-quality regulation ensures international network and service competition. New entrants penetrate the EU market, both from within and outside Europe. Consumers have ample buyers’ options both in service packages and in choosing between providers; they benefit from low prices and opt for advanced innovative solutions, income growth being high.

Implications of scenarios for jobs, skills and knowledge by job function

In determining job volume changes, a clear distinction should be made between mature, developed markets on the one hand and markets in transition on the other. Different scenarios show different job volume changes, with the *Mono-tech* and *Tech-com* scenarios showing a more positive development in overall job numbers than the other two scenarios.

For **managers**, the combination of fast technological progress, innovation and competition leads to more dynamic markets and ditto change which require quick and adequate reactions from managers. High income customers and growing markets on the other hand make it easier to manage a firm. In more mature markets, the number of managers is expected to be stable across all scenarios. Scenarios with strong market dynamics will particularly for markets in transition imply a demand for more managers. All four scenarios foresee technological progress and innovation, and hence a need to develop new products and improve existing ones, increasing the demand for **high-skilled engineers and IT professionals**, especially in *Mono-tech* and *Tech-com*. Infrastructure and equipment are supposed to be of better quality across the board, and hence require less maintenance and fewer **technicians**. Faster progress leads to faster improvement of quality but also brings about more problems caused by immature technologies. In an increasingly virtual society,

more and more sales take place over the Internet, hence decreasing the need for less educated face-to-face **sales personnel**. Competitive pressures, such as in *Tech-com*, stimulate the intensification of sales efforts. In *Mono-tech* the technology effect will dominate and the number of low educated sales personnel will decrease; in *Tech-com* technology and competition effects will balance out, keeping their number unchanged. In *Mono-tel* and *Tele-com* the demand for sales personnel will be stable, as both effects are weak.

Implications of scenarios: job volume changes by function, 2009-2020

	Market development	Mono-tel	Tele-com	Mono-tech	Tech-com
Managers	Developed	M	M	M	M
	In transition	M	M	I	I
Engineers & IT professionals	Developed	M	M	I	I
	In transition	M	M	I	I
Technicians	Developed	D	D	D	D
	In transition	D	D	D	D
Sales & marketing professionals	Developed	M	I	M	I
	In transition	M	I	M	I
Sales personnel	Developed	M	M	D	M
	In transition	M	M	D	M
Other professionals	Developed	M	I	M	M
	In transition	M	I	I	I
Administrative personnel	Developed	M	M	M	D
	In transition	M	D	M	D

Source: TNO-SEOR-ZSI. Note: D = decrease, I = increase, M = maintain.

High-educated **sales professionals** in *Mono-tech* and *Tech-com* - both characterised by fast technological progress - increasingly face the task of being able to translate technological innovations into marketable products. Furthermore, consumers need to be informed about new products and to be convinced to buy them. Both stimulate the demand for highly educated, creative marketing and sales professionals. In *Mono-tel* the number of sales professionals will be stable, however. In *Tele-com* little new innovative products, low income growth and strong competition makes selling difficult, which requires more sales professionals. The demand for **other professionals** is, just as the demand for managers, likely to increase with increasing market dynamics, with increasing ‘difficulty’ of markets and under a low pressure for rationalization. The number of other professionals remains stable in developed markets; in *Mono-tech* and *Tech-com* increases can be expected in markets in transition. In *Tele-com* other professionals are hired to replace for managers for cutting costs reasons, especially where analytical tasks are concerned, and hence increase. Fast technological progress, innovation and high income growth result in new products, increasing the demand for **administrative personnel**. Yet increasing automation will lessen the need for administrative personnel. In *Mono-tech* these effects will most likely balance out, resulting in stable demand for administrative personnel. In *Tech-com*, competitive pressures will dominate, resulting in decreasing administrative personnel numbers. With slow technological progress, not only the number of new products will be relatively little but also the drive for further automation. In the developed markets under *Mono-tel* and *Tele-com* therefore demand will remain constant. Competitive pressure for rationalization in *Tele-com* will lead to further decreases in administrative personnel in markets in transition.

Identification of emerging competences, skills and knowledge needs

By taking the scenarios and drivers as a starting point, logical inferences ('guestimates') of skills and knowledge needs were made for each of the identified job functions. *Skills* refer to the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualification Framework (EQF), skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments). *Knowledge* refers to the outcome of the accumulation of information through learning. It is the body of facts, principles, theories and practices that is related to a field of work or study. In EQF context, knowledge is described as theoretical and/or factual. *Competences* refer to the proven ability to use knowledge, skills and personal, social and/ or methodological abilities, in work or study situations and in professional and personal development. Competences thus defined come actually close to what is generally understood nowadays as 'soft skills'. In EQF context, competences are described in terms of responsibility and autonomy. In the practical elaboration of future skills and knowledge needs for the purpose of this study, both have been further 'disentangled' to result into six clusters of similar and related skills and knowledge needs (see Box).

Overview of skills and knowledge needs identified for each job function and scenario
Knowledge ('hard skills')
<ul style="list-style-type: none"> Legislative / regulatory knowledge (environmental / safety / labour / contracting); Language*; e-skills; Marketing skills; Technical knowledge; Product knowledge; Product development
Social Skills
<ul style="list-style-type: none"> Team working skills; Social perceptiveness (listening / understanding); Communication; Networking; Language*; Intercultural
Problem-solving Skills
<ul style="list-style-type: none"> Analytical skills; Interdisciplinary; Initiative, Multi-skilling; Creativity
Self-management Skills
<ul style="list-style-type: none"> Planning; Stress and time management; Flexibility; Multi-tasking
Management skills
<ul style="list-style-type: none"> Strategic & visionary; Coaching and team building; Change management; Project management; Process optimizing; Quality management; People skills crucial for collegial management style
Entrepreneurial skills
<ul style="list-style-type: none"> Supplier and customer relationship / understanding; Business understanding / development; Trend setting / trend spotting
Source: TNO-SEOR-ZSI

Future skills and knowledge needs by job function

Across all job functions soft skills will become increasingly important, especially so for high skilled professional job functions. The general trend of up-skilling across job functions is bound to continue in the coming years. Due to the changing nature of jobs, predefined technical knowledge capabilities will become somewhat less important while skills to adapt and learn new competences and life-long learning will be put at a premium. Certain knowledge – notably e-skills – will become more important. Emerging competences of higher skilled jobs mostly refer to *how* to learn, communicate, interact and adapt to changing environments in addition to a high quality education. Emerging competences in medium-

educated job functions that mostly execute defined tasks and processes refer mostly to specific knowledge sets that can be taught through learning.

We will illustrate the key emerging skills and knowledge needs for two of the seven distinguished job functions, i.e. managers, and engineers and IT professionals.²

Managers. Market dynamics - stimulated by fast technological progress and strong competition – is one of the main distinctive features between the scenarios. Cost management (no gold plating!) and optimising the value chain are important tasks for managers in the coming years, as is accommodating company culture from an engineering-solutions towards a cost conscious creative services-oriented culture. The more dynamic the environment, the stronger the variety of tasks required and the more ‘new’ skills will be demanded from managers.

Knowledge of technical developments is most required in scenarios with fast technological progress (*Mono-tech* and *Tech-com*). In the more competitive scenarios this knowledge is not only technological, but also cost-reduction oriented. Regulatory knowledge is needed in all scenarios, but with different emphasis. Also here managers will predominantly rely on other (legal) specialists’ knowledge and skills. *Tele-com* and *Tech-com* require a combination of legislative and regulatory knowledge, knowledge of societal innovation trends (e.g. ‘green IT’) and of what innovation policy options exist to help change and/or further improve existing business models. In the other two scenarios regulatory knowledge primarily serves to establish what is and what is not allowed and to ‘use’ regulation to increase opportunities.

Communication and networking skills are put at a premium in a highly networked – and internationalising - environment. In a monopolized market the regulator may want to impose restrictions on dominant firms, which will trigger counteracting lobbying and PR efforts. Low quality of institutions could increase the effectiveness of lobbying. In high competitive scenarios such communication skills are needed to engage in international competition. Under fast technological progress, co-operation with other firms is needed to set standards and ensure compatibility between different networks and services. Networking and communication skills can help to enable such co-operation. Team working needed to further facilitate technological convergence and new services requires co-operation between different specialists within the firm, but also with other firms. In *Mono-tech* and *Tech-com* problem solving skills, such as creativity and analytical skills are needed to perform analyses of the organisation/the value chain, whereas change management is required to win support for changes in the organisation. Fast technological progress will make it necessary to (re)formulate the company’s vision. Competitive pressure stimulates market dynamics and the need to be alert; self management skills such as planning and flexibility can help in responding quickly to competitors’ actions.

Engineers and IT professionals. The role of engineers and IT professionals is especially up for change in scenarios with strong technological change and ditto competition. Identifying and exploiting opportunities for translating technological advances into marketable products will be prime. Yet, the high profile of this job function will gradually lose its shining image (once having been the ‘kings’ of the sector). Additional and new knowledge will, for instance, include the ability to develop new software; convergence will require broader, interdisciplinary skills and knowledge, e.g. to be used in system integration and to develop hybrid, cross-media products. Knowledge about green IT-efficiency is particularly important

² For a summary of future skills and knowledge needs for these and other job categories, see the tables at the end of this summary. More extensive and detailed accounts on skills and knowledge needs can be found in the main report, with further differentiations made by scenario.

in *Tele-com* and *Tech-com*. Social skills such as team working, social perceptiveness, communication and networking are highly relevant in scenarios with much competitive pressure and fast technological change. Social and interdisciplinary skills are valuable assets in collaborating in multidisciplinary teams, which are vital to further strengthen innovation capabilities (developing integrated products using different technological aspects). Networking is also key to gathering information about technical developments, both from research institutions and competitors. Language and intercultural skills are important in *Mono-tech* and *Tech-com*, especially in across-border matrix organisations. Both also require substantial problem solving analytical skills and initiative, notably in a short-time-to-market environment.

These examples show that there will not only be a continuous trend of up-skilling in the coming years, but also that skills and knowledge needs – and related gaps and shortages – need to be addressed flexibly, taking in mind the trajectory of strategic change of both the firm and the sector.

Main strategic choices to meet skill and knowledge needs

In order to meet future skills and knowledge needs, apt and timely solutions – referred to here as strategic choices - are required (see table below). Strategic choices refer and relate to the medium- and longer term, even though emerging skills and knowledge needs in practice may also apply to the now and tomorrow. Essential in seeking appropriate solutions is to keep this longer time perspective in mind. Rather than focusing on one single solution, a set of linked strategic choices will in most cases be the best strategy to follow. Prioritising both in time (what first, where to follow up) and in allocation of resources (including budgetary focus) followed by further fine-tuning is a clear necessity to guarantee that skills needs are targeted and solved. Skill needs can be identified at various levels, ranging from assessments at the national or even European sector level to more precise assessments at the regional and company level. Increasingly the identification of skills and knowledge needs but also the search for adequate solutions will have to become an integral part of an overall longer-term business strategy, also for SMEs. Some solutions will be found within the company itself, e.g. through reorganising functions within or between plants, by offering (re)training trajectories or by active global sourcing of personnel. For SMEs and especially for micro-enterprises such longer-term, more strategic human resource management often will be more difficult to organise and operationalise.

In order to address the identified future skills and knowledge needs in an encompassing and timely manner, appropriate joint action is needed by all stakeholders, including the industry (firms, sector organisations and social partners), training and education institutes, intermediary organisations and, last but not least, government at all levels (EU, national, regional and local). Collaboration is needed in order to agree on and implement a package of feasible solutions. Timely, targeted and reliable information to make decisions – i.e. adequate monitoring and analysis - is an essential prerequisite.

Summary of job volumes, skills changes, strategic choices and main players in anticipatory action by scenario					
		Mono-tech	Tech-com	Mono-tel	Tele-com
Managers	1. Employment volume change	M / I	M / I	M / M	M / M
	2. Skills changes counted	13	21	3	8
	3. Emerging skills needs	Social, Management, Problem solving, Self-Management	Entrepreneurship, management, self-management, problem solving	Social skills, problem solving (interdisciplinary)	Social, Self-management, Entrepreneurship
	4. Most important solutions	In-house development, recruitment	In-house development, recruitment	In-house development, recruitment	In-house development, recruitment
	5. Most important actors	C	C	C	C
Engineers & IT professionals	1. Employment volume change	II / II	II / II	I / I	I / I
	2. Skills changes counted	16	19	2	13
	3. Emerging skills needs	Social skills, Knowledge (technical) , Management	Social skills, Knowledge (technical) , Management	Knowledge (technical)	Social skills, Knowledge (technical), Entrepreneurship
	4. Most important solutions	Recruiting, Training, Information, Image	Recruiting, Training, Information, Image	Recruiting, Training, Information, Image	Recruiting, Training, Information, Image
	5. Most important actors	C, E	C, E	C, E	C, E
Technicians	1. Employment volume change	D / D	D / D	D / D	D / D
	2. Skills changes counted	6	8	1	8
	3. Emerging skills needs	Social, Self-management, Technical Knowl, Multi-skills	Self-management, Social Technical Knowl, Multi-skilling	Knowledge	Self-management, Social, Technical Knowl, Multi-skilling
	4. Most important solutions	(Re)training, Information	(Re)training, Information	(Re)training, Information	(Re)training, Information
	5. Most important actors	C, E, S, U	C, E, S, U	C, E, S, U	C, E, S, U

C=Companies; S=Sectoral organisations, U=trade Unions; E=Education and training institutes; G=Government (EU, Member State, regional, local); I = Intermediary organizations.

Notes: 1) The term 'skills' includes knowledge (needs). 2) The second row 'skills changes counted' refers to the number of skills categories in the most extreme scenario that are up to change. 3) Indicated in bold: skills or knowledge sub-categories up for the strongest upgrade need.

		Mono-tech	Tech-com	Mono-tel	Tele-com
Sales & marketing professionals	1. Employment volume change	M / M	I / I	M / M	I / I
	2. Skills changes counted	5	16	2	12
	3. Emerging skills needs	Social, technical knowledge, entrepreneurship, management	Entrepreneurship, Social, Knowledge, Self-management, Problem-solving	Problem-solving, entrepreneurship	Entrepreneurship, Problem-solving, Self-management, knowledge
	4. Most important solutions	Re-training	Re-training, Recruiting	Re-training	Re-training,
	5. Most important actors	C, E	C, E	C, E	C, E
Sales personnel	1. Employment volume change	D / D	M / M	M / M	M / M
	2. Skills changes counted	5	12	0	7
	3. Emerging skills needs	Knowledge, Problem-solving	Social, Knowledge, Problem-solving, self-management, entrepreneurship	-	Social skills, Self-management, Entrepreneurship, Problem-solving
	4. Most important solutions	(Re)training, Information	(Re)training, Information	(Re)training, Information	(Re)training, Information
	5. Most important actors	C, E	C, E	C, E	C, E
Other professionals	1. Employment volume change	M / I	M / I	M / M	I / I
	2. Skills changes counted	7	11	3	10
	3. Emerging skills needs	Social, Knowledge, Problem-solving, Management	Social, Knowledge, Problem-solving, Management, Entrepreneurship	Social, Knowledge	Social, Knowledge, Problem-solving, Self-management, Management, Entrepr
	4. Most important solutions	Recruiting, Training	Recruiting, Training	(Re)training	Recruiting, Training
	5. Most important actors	C, E, U	C, E, U	C, E, U	C, E, U
Administrative personnel	1. Employment volume change	M / M	D / D	M / M	M / D
	2. Skills changes counted	10	13	4	11
	3. Emerging skills needs	Knowledge (e-skills) , Social, Self-management, Problem Solving, Change Management	Knowledge (e-skills), Social ,Self-management, Problem Solving, Change Management	Self-management, Change Management	Knowledge, Social,, Self-management, Change Management
	4. Most important solutions	(Re)training, Information	(Re)training, Information	(Re)training, Information	(Re)training, Information
	5. Most important actors	C, E	C, E	C, E	C, E

C=Companies; S=Sectoral organisations, U=trade Unions; E=Education and training institutes; G=Government (EU, Member State, regional, local); I = Intermediary organizations.

Conclusions

Implications, conclusions and recommendations refer to two distinct levels: the individual job function (micro) level focusing on available options by job function and the more aggregate generic 'meso-level' level. They are aimed at sectoral stakeholders (firms, social partner, education and training institutes and others) and policy-makers. The preceding table summarises the micro-level options and highlights the main findings by category. At the meso-level a further distinction is made between education and training on the one hand and 'other' main conclusions and recommendations on the other, as follows:

Conclusions and recommendations on education and training

- 1) Adapt and modernise vocational education and training (VET) and general education systems, but do this nationally rather than at the EU level;
- 2) Modernise VET by enhancing flexibility and addressing emerging training needs by modularisation;
- 3) Increase flexibility by promoting e-learning and blended learning and other learning forms;
- 4) Improve information provision on skill needs and job requirements: essential for training and education as well as for finding employment;
- 5) Provide better career guidance for those in search of a job;
- 6) Promote European-wide recognition and transferability of skills;
- 7) Prepare for training, re-training and up-skilling;
- 8) Provide special courses and support for older employees;
- 9) Stimulate multi-skilling;
- 10) Increase attention for interdisciplinary, social, problem-solving, self-management and service-related skills.

Main other conclusions and recommendations

- 1) Invest strongly in human capital – and put skills and knowledge more upfront;
- 2) Improve the image and attractiveness of the sector to technical, engineering and IT professions;
- 3) Bring engineering and science to the classroom;
- 4) Improve diversity in the sector, esp. in technical occupations, keep older workers in the sector, and improve the organisation of work;
- 5) Attract workers from outside the European Union;
- 6) Collaborate with all relevant stakeholders and intensify co-operation.