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Roadmapping in fast changing environments – the case of the Russian media industry

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ABSTRACT

Roadmapping is a useful instrument for developing strategic measures. Despite the importance of customizing roadmaps to firm/industry specific managerial needs and environmental conditions, the existing literature has focused on the simplified roadmapping process. Little attention has been paid to the customization of roadmaps. Our proposed methodological approach, suggested through a case study, brings together several targeted roadmaps and integrates them into one overarching roadmap — the umbrella roadmap as a new flexible systemic tool. The integrated umbrella roadmap delivers a framework of the industry/company's overall expectations (trends, etc.), whereas targeted roadmaps focus on local targets for a specific product/technology.

1. Introduction

From a company's point of view, technology roadmapping is a planning process which includes the choice and development of alternative technologies for satisfying the proper requirements of production. Thus, the roadmap building process depends on different factors such as market, culture, and resources as well as on the content and characteristics of the specific product (EIRMA, 1997). In other words, there is no special universal methodology for making roadmaps which can be widely applied by all companies and in all industries. Beeton (2007) distinguishes four common phases of creating roadmaps: planning; data collection; processing; and data interpretation. *The planning phase* involves creating and adjusting the purposes, scale, and main processes within a particular area. In *the data collection phase,* information and knowledge are gathered which are structured in the *information processing phase*. Finally, *the interpretation phase* consists of continuous monitoring and updating the reliability and relevance of information and knowledge (Lee et al., 2012). Technology roadmapping plays a role of major integrating framework and management method that supports the implementation of key technology management processes by uniting technology and market issues in order to promote strategical and innovation decisions (Moehrle Isenmann and Phaal, 2013).

Phaal et al. describe the three broadly different types of layers in a technology roadmapping process: the top layer relates to purpose and format, the bottom layer relates to resources (organization and the specific technology/competences that maintain given projects) (Phaal et al., 2004). The middle layer as the connection between the top and the bottom ones concerns to product or service

Abbreviations: ASO, analog switch off; DSO, digital Switch-Over; DTV, digital television; DTT, digital terrestrial TV; ICT, information and communication; IDP, innovation development program; ITU, International Telecommunication Union; OTT TV, Over-the-top TV; SEE, South-East European

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development that move technology to meet market and customer needs.

The main advantages of roadmaps lie in better planning and decision making. According to Beeton (2007), "one of the main hopes assigned to develop a roadmap is that it will offer the necessary information to make more informed decisions". In addition, he indicates that the roadmaps should meet expectations for the following reasons:

1) Determining the gap between the key technologies necessary to achieve goals;
2) Identifying ways to use R&D investments through the coordination of research activities both within companies and alliances or the whole industry.

Effective strategies of companies primarily focus on detecting and predicting future demand for innovative solutions and assessing the feasibility of introducing such solutions to the market. In this light, roadmaps are a key technique of Foresight and are especially important for strategy making that aim to:

i) identify the potential for new product development;
ii) introduce new processes in corporate activities;
iii) facilitate decision making;
iv) develop strategic priorities;
v) identify the main risks inherent to the company;
vi) identify the drivers of changing market conditions (Vishnevskiy et al., 2015a; Mendonça, 2001).

Roadmapping is a useful and flexible approach for developing strategic measures and activities, but the potential benefit may be fully exploited only while using instruments to fit the specific needs and/or to accommodate unusual circumstances of a particular project.

Foresight-based integrated roadmaps are special because they detect the long-term factors of the potential dynamics of demand, which the more traditional methods of marketing analysis can only do to a limited extent (Vishnevskiy et al., 2015a). Lee and Phaal also emphasize "the importance of having an integrated roadmapping process as a holistic framework for supporting improved decision-making". In their paper they consider an integrated roadmapping process as systematic, standardized and created for the development of integrated product and service strategies (Lee et al., 2017). As very complex system media sphere consists of different layers: content production, delivery and consumption. Each of these layers embraces a wide range of integrated products and services precipitously developing due to ICT improvement and penetration and technology convergence.

The integrated roadmap methodology on the basis of mobile communication has also been developed by An et al. in order to help experts of products and services to have a common vision and to save time and financial resources by avoiding many conflicts and modifications that could appear during a design process (An et al., 2008). Lichtenthaler suggests using the integrated form of product-technology roadmap to visualize the links across the technologies and the internal commercialization projects and across the external commercialization projects (Lichtenthaler, 2008).

In form, integrated roadmaps visualize both dimensions in one roadmap which is advantageous for top-level decision making and also brings the respective functions and units together to work cooperatively. In this article, targeted roadmaps allow us to zoom in to the level of a particular detailed forecast of product or technology in a fast-moving area. As concerns the speed of changes in our sense the fast pace of changes as we define them imply a considerable shortening of product life cycles, and a rapid obsolesce of technologies that can be detected in less than a year. Thus, we propose a system of integrated and targeted roadmaps in an "umbrella" roadmap that aims to construct a new methodology capable of taking global industry development and local coordination levels into account. The latter is subject to rapid change so it is necessary to create the industry vision frame (within the integrated roadmap) and the system of forecast to effectively monitor up-to-date changes.

Valuable attempts in the field of structuring and managing roadmapping for strategic foresight analyses of standardization were performed by Featherston et al. (2016), Ho and O'Sullivan (2016, 2017). Featherston et al. (2016) creates a framework to support the anticipation of standards with careful characterization of various technologies and innovation activities relevant to standardization. Ho and O'Sullivan present a new systematic process model for supporting future-oriented analyses of standardisation designed for highly complex heterogeneous smart systems. This process has been developed through the study of five major standardisation roadmapping exercises in various smart system domains (Ho and O'Sullivan, 2016, 2017).

In practice, it is indispensable to flexibly alter the general roadmapping process to accommodate firm-specific or industry-specific managerial needs and environmental conditions. If a roadmap is to be applied because strategic decisions based on roadmaps require awareness early on of current trends as well as of current and potential changes. This holds all the truer when it comes to environments which are characterized by significant changes taking place within a one year horizon. We call these industries or sectors fast-moving. Slow-moving industries, in contrast, see much more infrequent significant changes (e.g. every five years or more) affecting the operations of most of their participants (Vishnevskiy et al., 2016).

Accordingly, roadmapping must incorporate a forward-looking approach and take into account the potential changes in the corporate environment arising from changes in the competitive, technological, market (customers), environmental and political environments, among others. In this respect, Brown and Eisenhardt (1997) argue that "in high-velocity environments, characterized by frequent changes, short product cycles and fast moving landscapes, companies compete by having the capability to change continuously" (p.2). The telecommunication industry is a prominent example of how this continuous change determines not only several leading content-producing companies or device producers or operating companies but of the industry as a whole. The

Table 1
The 5 generation of innovation model and suitable type of roadmap.
Source: Rothwell, 1994; authors.

Innovation model	Time of appearance	Reasons	Understanding of innovation process	Type of roadmap
Technology push	From 1950 — mid-1960's	Fast economic growth and industrial expansion	simple linear and sequential with emphasis on R&D (a supply side approach of the innovation process)	Technology roadmap
Market pull	Mid 1960s — Early-1970s	'Market shares battle' with increased competition	linear and sequential, but now with emphasis on the market (domination of demand side factors)	Market roadmap
Coupling of R&D and marketing	Early 1970s — Mid-1980s	Rationalization is necessary under the pressure of inflation and stagflation (corporate consolidation)	coupling of markets needs and technological opportunities (a balanced role of R&D and marketing)	Technology push-market pull roadmap
Integrated business processes	Early 1980s—Early 1990s	'Time-based struggle' as product life cycles shortened	non-sequential, messy character of the innovation process, cross functional (emphasis on the concurrent learning with customers and suppliers)	Various types of integrated roadmaps
System integration and networking	From the 1990's onwards	Resource constraints became central	Networking processes and accelerated innovation	Umbrella roadmap

broadcasting industry is confronted with fast changes which involve content, hardware, and software; these developments will ultimately lead to reshaped innovation processes and substantial investment in the platform for the foreseeable future.

Companies are responding to these changes in different ways although a profound response by scholars to innovation in fast changing industries has yet to understand the mechanisms through which organizations develop strategic Foresight, which precedes continuous innovation and change (Costanzo, 2004). We try to research an under-researched phenomenon by applying the roadmaps system. This consists of an integrated roadmap, which incorporates the major future trends, whole industry market scenarios, key products, industry risks and challenges/factors, as well as several targeted roadmaps aimed at formulating strategies for a specific field of a fast-changing industry. In this article, we discuss a case study of the telecommunication industry as a part of the information and communication (ICT) field.

Besides these challenges, it appears that the nature of innovation today is fundamentally different from the earlier technology push and market pull approaches. This is mainly due to the increasing complexity and uncertainty of systems, the more distributed nature of knowledge creation and innovation, and finally the recognition of the close relationship between science, technology and society (De Moor et al., 2014).

Rothwell identified the 5 generation of innovation model from the 1950's till today: technology push, market pull, coupling of R&D and marketing, integrated business processes, system integration and networking (Rothwell, 1994) (Table 1).

As Rothwell (1994) states the most radical feature of the 5th generation innovation model is the wider use of "a powerful electronic toolkit" (i.e. new ICT technologies revolution) enhancing the efficiency of operations of the whole innovation process. The system integration and networking model implies both the vertical (suppliers are involved in the co-development of new products, and/or share the technical systems used for it) and the horizontal linkages (joint ventures, consortia, alliances, etc.) with suppliers and customers.

It follows that the continuing rapid expansion of the available knowledge and technology base imposes an increasing need for fast and coordinated decision making for companies in their technology and innovation strategies. This is also accompanied by greater uncertainty and risks in completion and anticipated impacts. Thus, new challenges arise concerning how to assess investments in activities with potential future commercial and economic impacts arise and which need flexible assessment tools that can support the creation of future scenarios and potential development paths (Khripunova et al., 2014; Vishnevskiy et al., 2015b).

The remainder of this article is as follows. Section 1 discusses the main global challenges and trends in telecommunications, its services and television broadcasting worldwide and the general features of Foresight in the media industry. The next section discusses the practices of roadmapping in the media sphere and outlines the shortcomings of existing roadmap approaches when applied to a fast-moving environment. Section 3 then describes the umbrella roadmap methodology and discusses the advantages of such a model for a dynamically changing environment. Finally, based on a Russian case study we consider the possibility of embedding an umbrella methodology into the system of strategic planning processes initiated by governments at various levels (national, regional, corporate) and at different time horizons (short, medium, and long-term). Therefore, the case study roadmap model illustrates the special features of coordination with government policy instruments.

2. Global and national challenges and trends in the telecommunications sphere

Nowadays new ICT technologies radically change almost all spheres of human activities. One of the most vivid examples is the convergence of ICT and media sphere: there is no media without ICT and no need for ICT without content and distribution channels. The consequences of this ICT penetration take places in IT, telecommunications, broadcasting and other media, market and policy coming together. The changes in the media sector reveal themselves at a horizontal level as well as vertically (Table 2).

Thank to ICT fast development (including the evolution of devices, content production processes and distribution platforms in media) many business processes have changed significantly: supply chain management (e.g. Gunasekaran and Ngai, 2004) or marketing (e.g. Chaffey et al., 2009), and ICT influences much on the overall productivity growth (Colecchia and Schreyer, 2002). We also noted that progress in such technology continues according to Moore's law (the number of transistors on integrated circuits doubles roughly every two years). Even if the speed of progress should diminish (Esmaeilzadeh et al., 2012), computer capacity will still increase significantly until 2020 (Keller and Heiko, 2014).

Media and all creative industries (Architecture, Art, Design, Games) have been transformed radically by the convergence of Internet, computing, big data analytics and new opportunities they allow for transmission, digital storage, reproduction of digital media etc. (Abbasi et al., 2017). Abbasi et al. highlight that creative industries are marked by considerable and rapid changes during the digital revolution and they are operating within complex business environments defined not only by the common business regulatory framework, however by broader political and social-cultural issues (intellectual property rights, piracy and taxation).

Table 2
Convergence of ICT and media sphere.
Source: Henten et al., 2002; authors.

	IT	Telecom	Broadcasting	Other media
Content and services	Software based content	Telecom based services and content	Broadcast programs	Films, music, newspapers etc.
Distribution platform (software)	Generic software	Network services	Transmission	Cinema, video rentals etc.
Device (hardware)	Hardware	Telecom equipment	Broadcast equipment	Reproduction of films, printing etc.

Fig. 1. Main global trends in the media sphere.
Source: International Telecommunication Union, 2013; Digital TV Research, 2014a, b; authors.

(Abbasi et al., 2017).

Today's telecommunication industry as a part of the ICT sphere is undergoing fast and significant changes. Digital television (DTV) has ushered in a new era of broadcasting (Adda and Ottaviani, 2005). Due to the ICT and media convergence there are a lot of various technological factors influencing the innovation process in the media industry including Digital TV transition possibility: developments in the smartphone, Internet, cloud computing, big data analytics etc. The fast speed of innovation in these technologies affect the service and provider world that in its turn interfere with digital TV strategy and direction. The innovation implementation in given technologies as well as in business models and market strategies is characterized by very high speed due to the dynamic progress in ICT and its convergence with media so it is justified to consider media as the whole and the telecom in particular as fast-moving spheres.

It incorporates the computer into television viewing, creating an intelligent device that provides not only high-quality broadcast programming but also a variety of information services much like the current networked-computers. The DTV transition provides an opportunity for a country to open a more affordable broadband channel to homes and businesses (Shin and Song, 2012). It should be noted that upgrading terrestrial television network from analog to digital, through a process of "Digital Switch-Over" (DSO), has several benefits. First, it provides a step increase in quality and capability for the viewer. Second, because digital TV uses the spectrum more efficiently, it releases a highly valuable resource namely, blocks of frequencies in the UHF spectrum that can be put to good use. This forms part of the so-called "Digital Dividend" (Lawson, 2014). New types of communication (mass-individual communication – by Castells, 2009) appeared a few decades ago and have set the direction of future developments in the media and determined the factors of its evolutionary process. Mass-individual communication is characterized by the following features (see also Fig. 1):

We distinguish several global societal trends in the media industry related to globalization and the challenges connected with these trends:

The changing structure of demand for content and the audience preferences — increased focus on individualized content consumption

The audiences of universal channels are aging everywhere; consequently, these channels are becoming less attractive for the most accommodated and independent section of the population. In its versatility, TV no longer seems to act as a source of information; rather, television has become "the producer of emotions" (extraordinary and catastrophic events such as war and floods).

Television of "big" channels and niche television (specialized, thematic content and individual as opposed to a linear-type consumption) work for some groups. The first group includes an older audience which is not socially active and unprepared for innovations due to limited funds and an unwillingness to explore new media and gadgets and change their consumption habits. This group does not feel the need for social mobility or making quick decisions. The second group, in turn, consists of young, independent, educated, mobile, and enterprising consumers.

Changes in the philosophy and characteristics of the traditional genres

Information, analysis, documentaries, journalism, and educational broadcasting are still useful for structuring the broadcast referring to the thematic focus of the channel. However, in terms of the perception of the content and structure of the demand for it, all this diversity of genres is reduced essentially to two areas: infotainment and "intellitainment".

Changing the basis of media channels differentiation

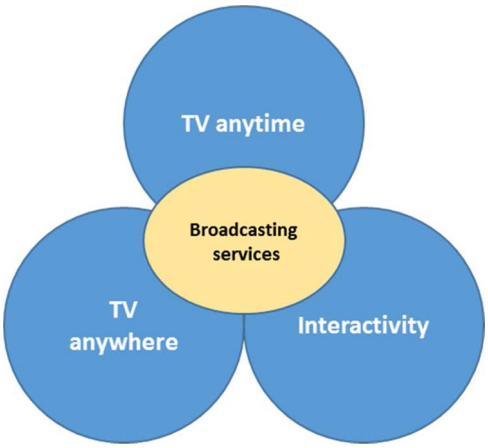


Fig. 2. Three main concepts of enhanced broadcasting services development.

The social characteristics of the audience have become much more important compared to the subject of broadcasting. TV is evolving into an exclusive entertainment space. Now the key differences between the channels (in terms of the type of content and delivery methods) are primarily of a social and class character.

Enhanced broadcasting services develop around three concepts (International Telecommunication Union, 2013; Neef et al., 2011) (Fig. 2):

1. TV anytime: lets the viewer choose when to watch a specific program. Time shifted viewing is in particular of interest for shows, documentaries, movies etc.; a relative short time shift for sports and news programs is also popular.
2. TV anywhere: this enables viewers to watch the broadcast service anywhere, whether in the living room, bedroom, or other room, or on the move. Mobile devices like smart phones and tablet computers are increasingly used for this application.
3. Interactivity: such a feature enables viewers to contribute or react to a specific program, demand additional information about the program, or get programs or information of particular interest (OTT and “second screen”).

3. Roadmapping practices in the media industry

We have analyzed several roadmaps in the media sphere, namely: DigiTAG (DigiTAG, 2014); Roadmaps of the International Telecommunication Union (International Telecommunication Union, 2010, 2012a, 2012b, 2013); and the South-East European (SEE) Strategic Roadmap to Digitalization including ten countries (Digi TV, 2012). It should be noted that publicly available (open access) roadmaps mostly aim to create a detailed plan for the transition from analog to digital television.

Initially, we have analysed the initial scope of the referenced roadmaps. The aim of the DigiTag report is to describe the future technology of digital terrestrial TV (DTT) focused on European countries, and to show that DTT standards are developing to meet the expected evolution of services and consumer requirements. The main purpose of the ITU roadmap model was to smooth the transition process from analog to digital television and facilitate the digital switch-over objectives (DSO). The SEE Strategic Roadmap to Digitalization aims to formulate proposals and recommendations for the media digitalization strategy of the SEE area and provide a pragmatic methodology for transitioning to the digital system in the respective countries. Finally, the roadmap of the Russian media communication union was created to develop a common vision of media industry development in Russia and align the interests of the major players on the media market in the future.

Taken together, these roadmaps cover large areas of the world including both developed and developing countries (Fig. 3).

The DigiTAG roadmap covers 10 of the most developed European countries, outlining the future development of digital terrestrial TV (DTT) until at least 2030. This goal stems from the fact that most European countries have already passed the stage of Analog switch off (ASO) and are now focused on new technologies and innovation and the transition to higher standards to meet the needs of consumers of TV signal. Hence, the roadmap looks at the development of standard digital terrestrial TV in the direction of new services and basic user request features. It postulates that image quality is improved (SDTV, HDTV and UHDTV), as are coding standards (MPEG-2, MPEG4 and HEVC) and new generation input signal transmission standards (DVB-T2), affecting the expansion of service offerings TV. The dominant feature is the consideration of trends in the technical area and the identification of promising innovative products on the market. Core elements of the DigiTAG are “DigiTAG Profiles” which define three simple stages of market evolution based mainly on the technologies that are core to DTT. Each profile shows a different level of development in terms of DTT channel format, encoding, and transmission standards (Fig. 4).

It is expected that the full transition to future DTT technologies may take between three and 12 years, depending on the adoption typologies of the countries involved. The full transition to the next stage of DTT technology, Profile 2 (DVB-T2, MPEG4/HEVC, SDTV/HDTV/UHDTV[4][4k]), will need a new TV renovation cycle involving different transmission and encoding standards, and may take between three and 12 years, depending on country-specific circumstances. It can take an early adopter between three and six years

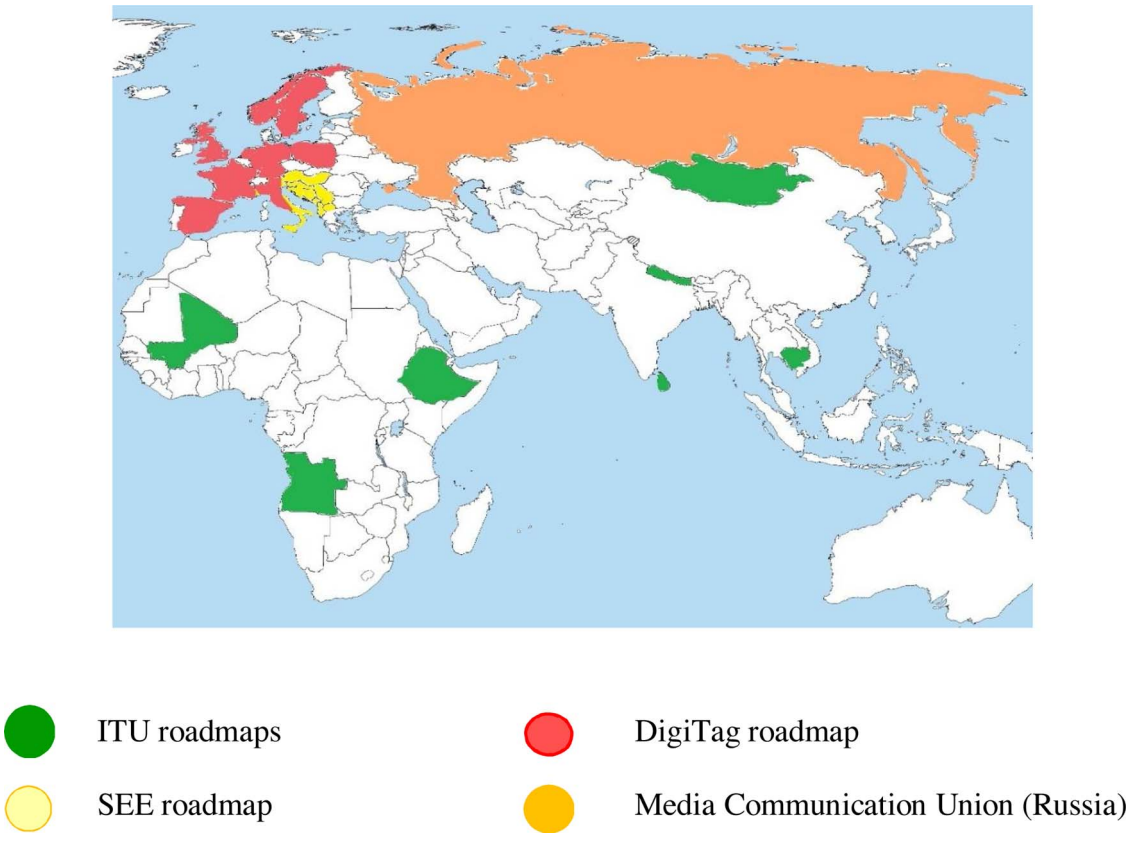


Fig. 3. Areas covered by roadmaps analysed in the article.

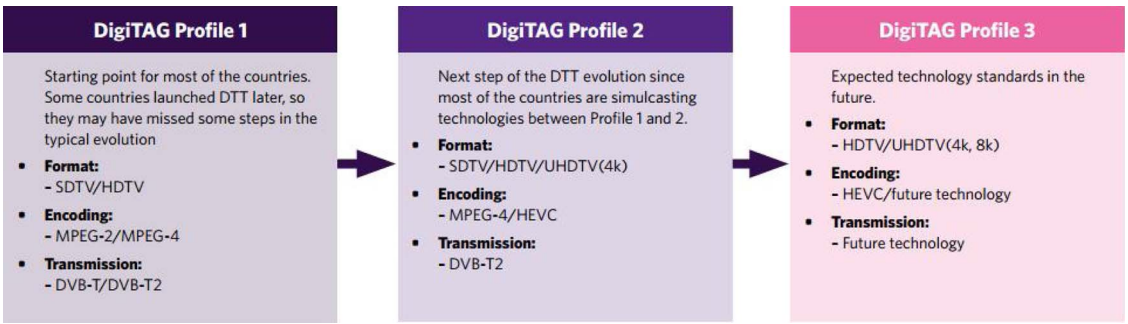


Fig. 4. Three stages of DTT evolution process according to a DigiTAG roadmap.

and a late majority between eight and 12 years. This transition will be able to meet consumer demand and expectations for HD and UHD TV content. Most countries are likely to introduce DigiTAG Profile 2 between 2017 and 2026 whilst continuing to develop the platform to DigiTAG Profile 3 between 2023 and 2030 and beyond (DigiTAG, 2014) (Fig. 5).

Roadmaps, established with the support of the International Telecommunication Union (ITU) according to the "Guidelines for the transition from analog to digital broadcasting" (International Telecommunication Union, 2010), were created to help successfully implement the transition to digital television. These Guidelines, originally designed for the developing African countries, were later used to create roadmaps in developing countries in the Asia-Pacific region and are intended to provide information and recommendations on policy, regulation, technologies, network planning, customer awareness, and business planning for the smooth introduction of digital terrestrial television and mobile television. Besides, the ITU-R BT.2140 report deals with the transition from analog to digital broadcasting.

The roadmap for Angola is designed for the medium- (2012–2015) and long-term (2015 and beyond). However, the focus of the map is on the preparation and implementation of the transition to a digital signal in 2015. The roadmap is constructed by defining the phases and by placing the relevant functional blocks in each phase in a logical order and in a time frame. For each of the functional building blocks, it identifies the decisions already taken and the main activities to resolve on still undecided key topics and choices.

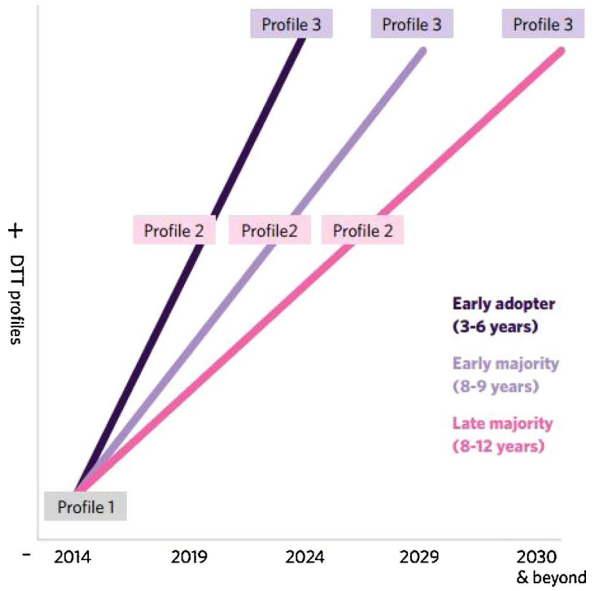


Fig. 5. Illustrative adoption roadmap for each type of country.

Functional layers A (Policy and Regulation), B (ASO), C (Market and Business Development) and D (Networks) contain 38 functional building blocks in total. Out of the 38 functional building blocks, 26 blocks were selected to construct the Angola roadmap.

The South-East European Strategic Roadmap to Digitalization consists of recommendations for the media digitalization strategy of the SEE area and provides a methodology for transitioning to the digital system in the different countries. The report provides implementation strategies and the necessary information on how to promote the migration to digital terrestrial television and to the latest digital transmission, compression technologies, as well as sets indicative deadlines for the switchover process.

The roadmap of the Russian Media Communication Union was created in 2014 and was last updated in 2015. The main goal of this initiative is to focus on developing new business models, prompt reactions to emerging trends, as well as broaden efforts to reduce piracy in the Russian media market (Media-communication Union, 2015).

The analysis of different related roadmaps shows that the scope varies depending on the region or country under review. In other words, the scope of roadmaps is driven by the development stage of the countries in question. Accordingly, the roadmaps are structured differently and have diverging time horizons (Table 3).

All the roadmaps discussed above show the main Foresight features but only partially meet all the requirements for roadmaps in a fast-moving media industry. While one roadmap merely gives a picture of further development needed in the industry, namely the trends, legal framework, and risk analysis without an in-depth study of these issues, the others concentrate on the narrow features of separate elements and miss the general systemic approach. This inspired us to develop a new roadmap model for fast-changing industries, which can be applied by companies, industry unions, or state-own companies in the media industry and can become integral to systemic strategic planning processes at different levels.

4. Methodology

4.1. Umbrella approach to roadmapping: defining the scope of roadmaps

The frequency and impact of change raises the challenge of constructing an up-to-date roadmap. The choice of roadmap methodology is also affected by resources: technological and physical infrastructure, budgetary, availability of expertise, leadership support, and time. In order to overcome these hurdles, we propose a methodology to develop a set of targeted roadmaps under a broader umbrella theme (“umbrella roadmap”). The umbrella roadmap involves integrated roadmaps which are directed at narrower fields, hence forming specified targeted roadmaps.

The umbrella roadmap is in the upper right corner of the figure which presents the scale and accuracy of roadmaps (Fig. 6). Whereas the accuracy and level of detail is highest for targeted integrated roadmaps, the umbrella roadmap is a generic roadmap which has a broader scope but for reasons of applicability and the initial purpose of monitoring, the overarching development and the level of detail in the roadmap is smaller. Accordingly, the accuracy/detail level is high when the roadmap mirrors the overall industry understanding, setting industry targets and expectations. When the scale/scope decrease, the research underlying the roadmap focuses on local targets of the Foresight process in a specific product or technology change. When the scale of the roadmap is reduced, we get greater specification, and research is concentrated to the level of studying the long-term forecasting of a particular subject area.\

Thus, an umbrella roadmap accommodates general industry trends, major challenges and opportunities, the list of products and

Table 3
Comparison of various Media Industry roadmaps (DigiTAG, ITU, South Eastern, Russian Media Communication).

	DigiTAG roadmap	Roadmaps of ITU (Transition from analog to digital)	South-East European Strategic Roadmap to Digitalization (ten countries)	Strategy of Russian Media Communication Union
Aim of roadmap	- Description of future digital terrestrial TV technology (DTT) focus on European countries show that DTT standards are developing to meet expected evolution of services and user requirements	Roadmap for the transition from analog to digital TV covers digital switch-over (DSO) objectives up to the year that analog TV switch-off will be completed aim of roadmap is to facilitate the DSO objectives.	- Proposals and recommendations for the media digitalization strategy - Methodology for transition to digital system in different countries considers the complex correlation between technical, regulatory, and socio-economic elements in the broadcasting sector and different stages of the migration process in individual countries	– To investigate a common vision of the industry's development in Russia and worldwide – To attempt to reconcile the interests of the major players on the media market in the future
Roadmap structure	- Four main parts: ○ Section 3: overview of main drivers that will determine the adoption and growth of DTT technologies in Europe up to 2030 and beyond; ○ Section 4 − current situation with DTT in Europe; ○ Section 5: potential future of European DTT market based on "DigiTAG Profiles" (define three stages of technology adoption in a country); ○ Conclusions related to present role of the DTT platform; ○ Expected evolution over the coming 15 years.	- The starting point for developing the roadmap was an analysis of the current TV market and regulatory framework. - Example roadmap Angola: ○ ○ 1: DTTB and MTV policy development;2: ASO planning3: Licensing policy and regulation4: Network planning and implementation; ○ 5: License administration. - Analysis of roadmap phases describes inputs and outputs including: ○ functional building blocks described in the ITU Guidelines ○ nonspecific DTTB main activities; not described in the ITU Guidelines ○ input or output documents ○ important milestones in relation to time scales.	- general overview of DTT in countries under research and France/UK. - models for 3 groups of countries according to the different stages in the introduction of technologies. - 1 cluster there DTT has been successfully launched (Italy, Croatia, Slovenia, Austria, Hungary) - 2 cluster where DTT services have already been initiated and commercial activities have been launched (Albania, Macedonia) - 3 cluster where regulatory framework DTT launch has not yet been completed and DTT transition still at early stage (Serbia, Montenegro, Bosnia and Herzegovina).	- Description of new paradigm that assumes erasing borders between different business models in media sphere - Considers principal trends and challenges. - Two basic scenarios of industry evolution: perspective and emergency scenarios. - Two strategic development directions and possible solutions to supposed key problems with indication of terms, participants, and expected results.
Type of roadmap	- Technological	- Managerial - Analysis of the possibility of using modern media technologies in the country and recommendations for a smooth transition to innovations.	- Managerial - Annexes include: ○ overview of new technologies and services; ○ Transmission techniques ○ Strategies and regulations to deploy digital broadcasting technology in the EU ○ New technologies and services in the EU.	- Managerial
Time horizon	2014–2030 and beyond	DSO objectives divided ○ Short-term (2012 to 2015) ○ Long-term (after 2015) objectives.	2012–2015 and beyond	2014–2024
Analysis of law and regulation	■□□□□	■■□□□	■■□□□	□□□□□
Risk analysis	■□□□□	■■□□□	■□□□□	■□□□□

Source: authors.

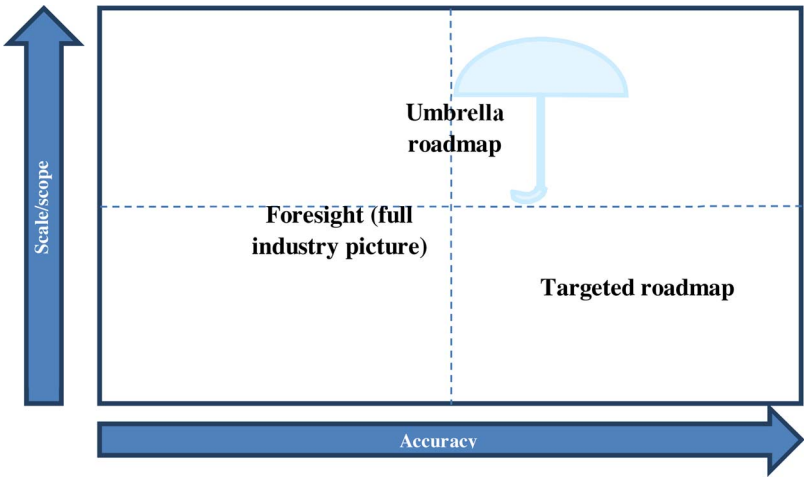


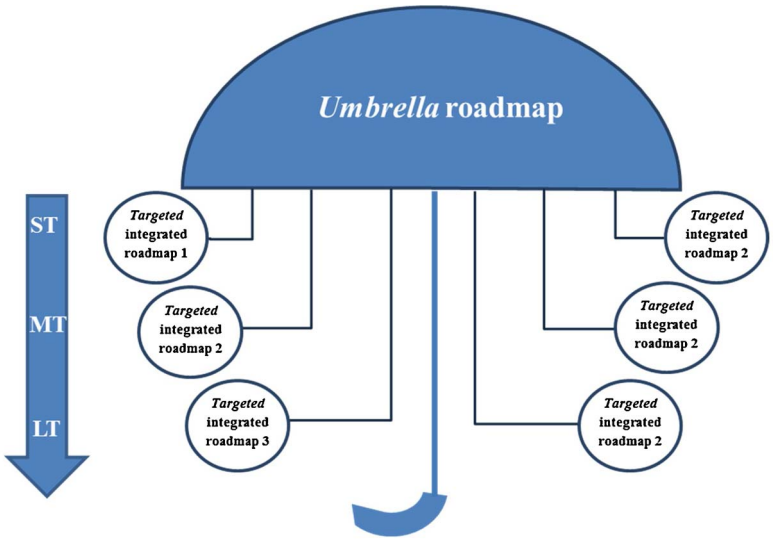
Fig. 6. The position of "umbrella roadmaps" and targeted integrated roadmaps.

services (in the TV industry for example, this includes the broadcast platform, methods of content delivery, etc.), the list of markets, and major scenarios of market development. In this respect, the umbrella roadmap links together the different targeted roadmaps and allows seeinga bigger picture of the industry or technology. Furthermore, if environmentally induced changes appear which effect one or more applications, e.g. technologies, markets or products, it is sufficient to update the targeted roadmap rather than revise the umbrella roadmap fully. This is because the umbrella roadmap integrates the underlying targeted roadmaps sufficiently.

The umbrella roadmap is broader than just an industry roadmap not only by the fact that umbrella always presumes targeted roadmaps existence but by the principle of its creation — to cover a wide range of issues related simultaneously to several specific targeted roadmaps no matter if they are building for a corporate or industry or technology level.

The umbrella roadmap creates a framework and general structure for several smaller targeted roadmaps that are integratedinto it. When creating the targeted roadmap, we choose the relevant trends, risks, markets, and legal framework from the umbrella roadmap and describe it in-depth. Thus this allows us to monitor changes in a specific product, technology or market as defined by the focus chosen at the start of the Foresight roadmapping process thatare crucial for stakeholders (Fig. 7).

Clearly, for targeted roadmaps in a fast-moving environment it would be not be convenient to carry out full-scale, in-depth



ST	Short-term (less than 1 year)
MT	Middle-term (1-5 years)
LT	Long-term (more than 5 years)

Fig. 7. Umbrella roadmap system.

research that reflects all the trends, products, risks, etc. within the whole industry. Over the course of the study, many of the characteristics of the products and technologies may change.

In turn, targeted roadmaps must meet the following criteria:

1. They aim to describe one specific area, and provide a detailed picture of changes in a product or technology in the future;
2. Less time and resources should be allocated to creating them compared to integrated roadmaps;
3. The "linking system" should be formed between the pool of targeted roadmaps (they can be made based on the same pattern);
4. They give potential for relatively rapid implementations of innovations in practice.

There are many differences between the various targeted roadmaps united by an umbrella roadmap due to the specificities of segments, products, and technologies that are examined in targeted roadmaps. Diverse targeted roadmaps imply a distinction between time horizons (short-, mid- and long-term). One of the advantages of the umbrella model is that it lets you make roadmaps for different planning periods by aggregating individual roadmaps into an integrated one. This leads to substantial resource and time savings during the Foresight process at the same time as a greater systemic understanding when creating targeted roadmaps. For example, there is no need to conduct very expensive and lengthy methods to get expert advice for each targeted roadmap because an integrated roadmap covers the common and essential "high-level" issues (global trends, risks, challenges etc.).

Moreover, the process of formulating an umbrella roadmap can be either top-down or bottom-up. Analysis of bottom-up approaches was held by Muller (2011) and it implies that the start of the process should be bottom-up followed by iteration, and top-down presentation. We suggestThat a typical umbrella model presumes that the process of creating an umbrella roadmap begins with an integrated roadmap defining the whole framework for a particular industry/sector, and continues with making targeted roadmaps. In contrast, making an inverted umbrella roadmap implies elaborating individual targeted roadmaps, which are then brought under an unifying framework in the form of an umbrella roadmap. It can be visualized as either a typical or an inverted umbrella.

5. Results

5.1. Ways to use an umbrella roadmap in developing the system of innovation (Russian case study)

Roadmaps initially developed as tools in the corporate company world. They have been increasingly picked up by public bodies for regional development strategies, namely in light of the widespread use of smart specialization strategies in the last two decades. However, to date there have been very few efforts to connect roadmaps developed in the context of smart specialization strategies and corporate roadmaps.

Russia today is following a path of a system of strategic planning, building on all levels (national, regional, corporate) and applying the Foresight methodologies including roadmapping. One of the significant steps in this process is that in 2015 the Russian Federation released new methodological recommendations for state-owned companies in order to help them make their own innovation development programs (IDPs) (Gershman et al., 2016; Ministry of Economic Development, 2015). These recommendations are also widely used by other companies willing to establish innovativeorporate development initiatives. Consequently, our roadmap model may be successfully embedded into the structure of innovation strategies used by both public and private bodies (Kindras et al., 2014).

Our pilot project on the telecommunications industry found that an umbrella roadmap model may be successfully inscribed into the system of strategic planning in the Russian Federation (Fig. 8). The systemic view of umbrella roadmaps lets you create targeted roadmaps with an "umbrella roof" on each level, whether that is national, regional, industrial, or corporate. On the figure there are several key objectives of strategic plans (on four major levels). For example, identification of the main technological development priorities of the industry, determination of major challenges and development factors, definition of the cooperation directions and priorities are key selective tasks for industry development strategy in Russia. As for ovals they represent the main regulating documents (federal laws, state programs and innovation development programs) that create a regulative frame for our telecom roadmap.

Umbrella roadmaps and targeted roadmaps allow companies to build up from the major principles of IDPs such as: a long-term forecast (global and national trends, strategies of industries development, etc.); enhancing the role of innovation (embedding innovation in key investment projects and products, bringing key innovation development goals to the attention of middle management and staff, etc.); introducing modern innovation portfolio management standards; and stimulating investments in Russian technology and import substitution projects.

We have developed a targeted roadmap that includes six layers: challenges and goals; technologies; products; markets; risks, limitations, and barriers; and legal and political limitations and possible solutions. **The first layer** (challenges and goals) describes the major developmental factors and challenges in the telecommunications industry. This layer reflects the potential that might arise from development and proposed goals to achieve this. Also it contains a profound analysis of the obstacles and challenges likely to impact development and hinder the achievement of the goals. The **second layer** (technologies) describes the respective technological trends and their diffusion over time, e.g. in the short, medium and long-term. The technology trends are identified by analysing bibliometrics and patent statistics as well as by employing related Foresight methodologies. Products, including services, are the subject of the **third layer** which is devoted to the description and analysis of the strategies of different television platforms (e.g. digital terrestrial TV, mobile TV, Cable TV, Satellite TV and types of television viewing (e.g., Smart-TV, Internet video library, shifted television, etc.). The **fourth layer** (markets) is a market analysis for two time horizons. During the project, we held several expert

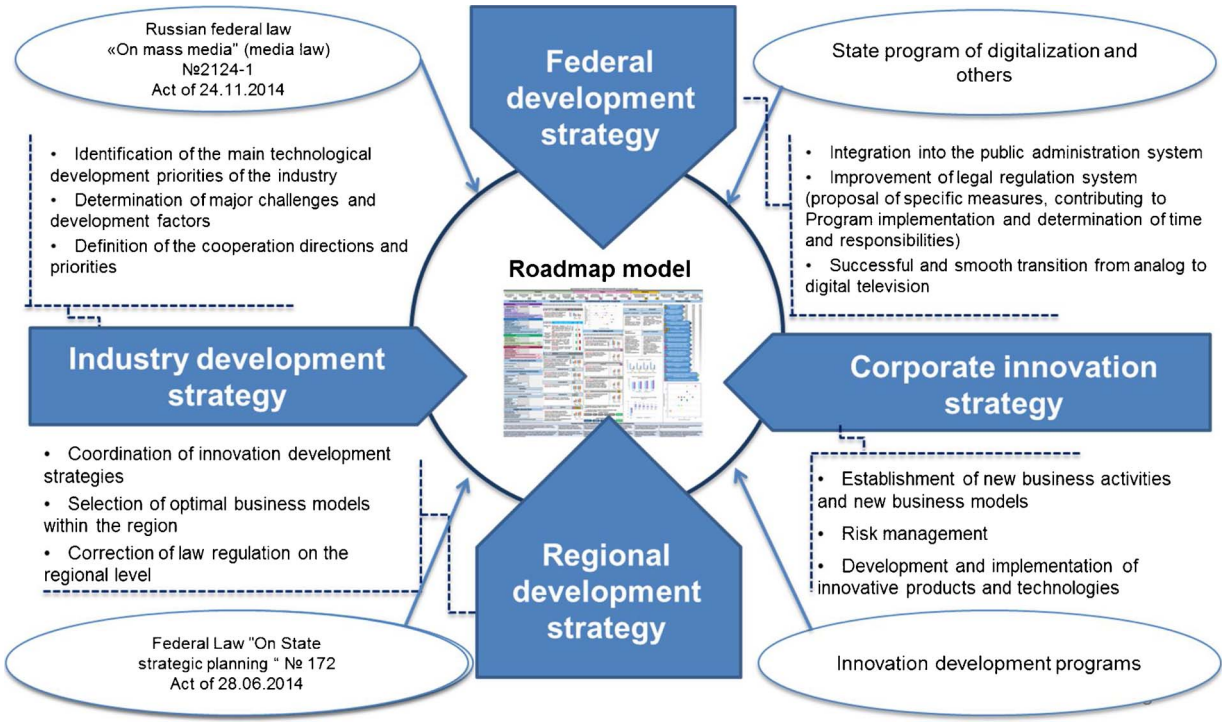


Fig. 8. The integration of an umbrella roadmap into the system of innovation development.

polls and undertook regression analyses of the impacts of different factors in order to create several scenarios of market development. The fifth **layer** (risks, limitations, and barriers) describes the threats and risks associated with the factors in the development of broadcasting having the greatest impact on the telecommunications ecosystem in the short, medium, and long-term. This layer also provides a graphical representation of the ranking, placing the risks and threats in order of importance and the likelihood of occurring. The **final, sixth layer** (legal and political limitations and possible solutions) describes the main legal constraints to the long-term development of broadcasting and possible measures to overcome them.

The layers of targeted or integrated roadmaps cannot be limited by only mentioned above 6 layers in the Russian case study; they should be adapted to the specific needs of a particular project in the fast-moving industry (for example, nanotechnologies, biotechnologies etc.).

In devising the targeted roadmaps, we relied on the Russian government's recommendations for IDPs. We tried to take into account all the strategic points of these recommendations to insert roadmaps into the wider field of strategic planning system in Russia. Fig. 9 shows how the targeted roadmap scheme and a targeted roadmap for telecommunications and the IDP for the telecommunication sector are related. Following the structure of the IDPs, we inscribed the following into our targeted roadmap: objectives and key performance indicators (KPIs); development and implementation of innovative products and technologies; benchmarking; financing; innovation projects; areas for cooperation, etc.

One of the advantages of our targeted roadmap is that it thoroughly analyses the legal framework to identify the legal and political limitations and threats and, thus, to propose ways to overcome them. Ultimately, based on the roadmap, it is possible to develop a list of specific measures to form a pool of documents that contribute to implementing corporate IDPs and roadmaps, and determine the timescales and responsibilities (Fig. 10). In the literature some authors notice that only several studies consider policy dimensions of technology roadmapping or regulatory frameworks (Zhou et al., 2013; Daim et al., 2012) and a method is need to integrate business modelling, policy, and regulatory factors into technology roadmapping (Cowan and Daim, 2016).

Thus, we identify the results to be achieved by implementing the selected activities. In our pilot project, the targeted roadmap not only comprehensively examines the prospects for the development of broadcasting and media technologies in the long-term, however it enables you to adopt specific management decisions at the corporate and federal levels.

To help build a systemic view, we integrated the corporate IDP (telecommunications industry) and the government-initiated 'Russia 2030: S&T Foresight', into which the telecommunications case study was included (Fig. 11).

These priority sectors are characterized by rapid changes and decision-making processes connected with the emergence of disruptive technologies, appearance of new markets and economic models, and fierce competitive environments. Research into each of these sectors embraced the technological thematic fields. For example, ICT has the following seven fields (algorithms and software, data processing and analysis technologies, computer architectures and systems, element base, electronic devices, robotics, predictive modelling, prospective system functioning, information security, and telecommunications). They classified by three time frames: short-, medium, and long-term changes. Our targeted roadmap for telecommunications (including four sub-sectors: new data transfer

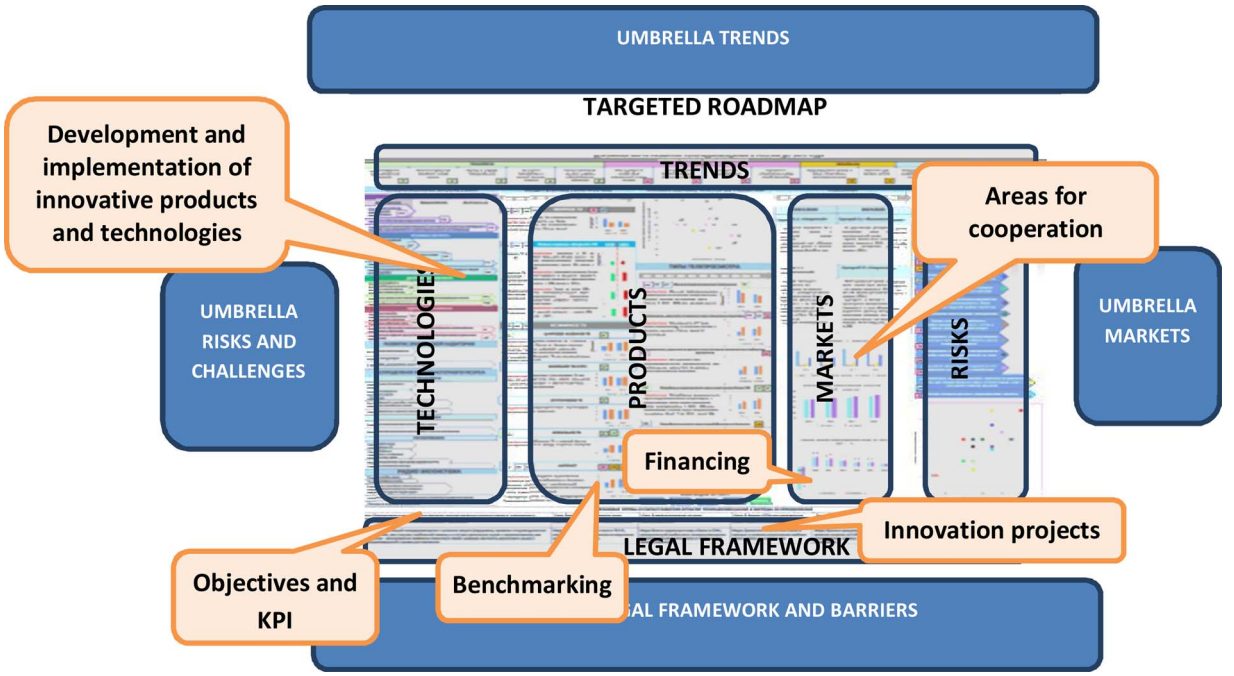


Fig. 9. Connection between a targeted roadmap for telecommunications and an IDP for the telecommunications sector.

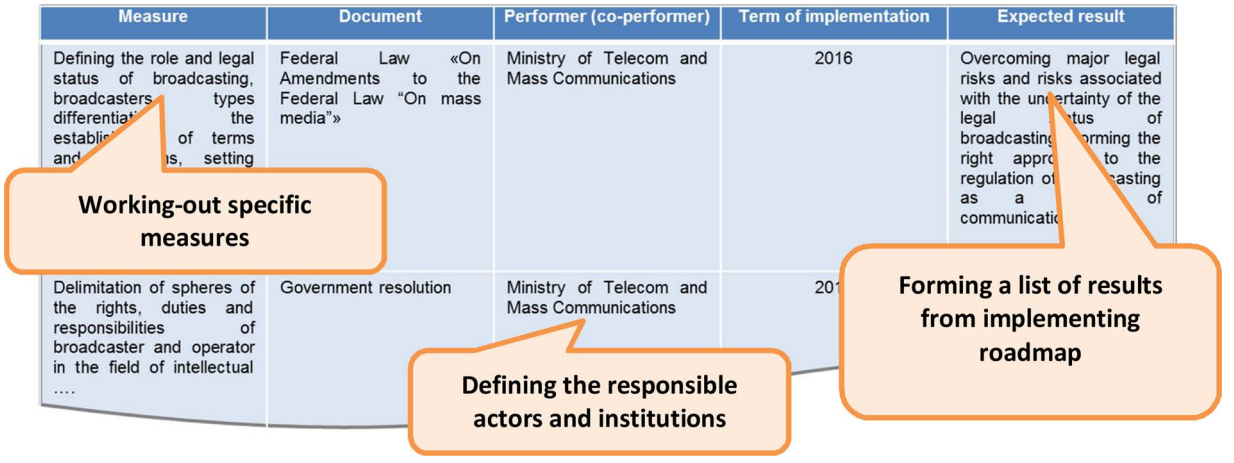


Fig. 10. Example of a list of possible solutions to overcome the legal limitations, documents and expected results with allocated timescales and responsibilities.

technologies, novel network organization technologies, new content distribution technologies, digital reality technologies and systems, and prospective human-ICT interfaces) also became part of an in-depth research project carried out by the National Research University Higher School of Economics for the 'Russia 2030: S&T Foresight' process.

6. Discussion

The umbrella roadmap methodological approach proposed here enables the user to effectively monitor changes and make appropriate decisions in fast-moving environments characterized by very high speeds of innovative technology and product creation and implementation. The nature of the umbrella model represents the system of targeted roadmaps with narrow scope into an overarching roadmap. It makes it possible to build roadmaps for different planning periods (short, medium, and long-term) and for various products or technologies by aggregating individual roadmaps in an integrated umbrella roadmap. In addition, it leads to substantial resource and time savings during the Foresight process at the same time as better systemic understanding when drawing up targeted roadmaps. Furthermore, targeted roadmaps can be easily updated without rebuilding the full umbrella roadmap.

This article and the methodological approach we propose also to offer managerial implications for practitioners involved in the strategic planning process. An umbrella roadmap system can be easily adapted for the system of innovation development at national,

Fig. 11. The place of the telecommunications sector in 'Russia 2030: S&T Foresight'.
Russia 2030: S&T Foresight consists of other priority sectors: 1 — Biotechnology, 2 — Medicine & Healthcare, 3 — New materials & Nanotechnologies, 4 — Information and Communication Technology (ICT), 5 — Environmental management, 6 — Transport & Space systems, 7 — Energy efficiency and Energy saving.

regional, industry, and corporate levels due to its inherent combination of a systemic view with the specificities of a particular technology/product innovation development. Ongoing developments of the other targeted roadmaps within the Russia 2030: S&T Foresight confirmed the necessity of having broader umbrella roadmap describing the ICT industry framework.

Nevertheless, there are several possible limitations of our model. Linkages between individual targeted roadmaps are not always fully clear and plausible, so further development of the umbrella roadmap model is needed by applying it to different spheres at various levels. Moreover, it is an open question regarding the direction of causality between targeted and integrated roadmaps, and the parameters defining the initial steps of creating an umbrella roadmap. Besides, one of the broadest and most interesting themes for future research concerns the scope of umbrella roadmaps. In the case of applying umbrella models at the corporate level (predominantly in large companies), the question of the scope of integrated and targeted roadmaps is rather subjective as is the question of updating roadmaps. If the umbrella concept is applied in large corporations (different business units are active in various industries that have diverse rules and regulations), it might include completely dissimilar business dimensions.

7. Conclusion

Trend analysis showed that the telecommunications sector is today undergoing significant changes at an unprecedented rate. This observation is confirmed by the growing number of roadmaps in this sphere. Fast-changing environment conditions and the need to perform strategic decisions while being aware early on of the current trends and potential changes justify a flexible umbrella roadmap model. The umbrella roadmap creates a framework for several smaller targeted roadmaps, which are inscribed in the general structure of the former.

Roadmaps initially destined for corporate companies during the past few decades have become part of the development strategies of public authorities globally. Our umbrella roadmap model is an attempt to adapt roadmapping instruments for the needs of strategic planning at different levels. Our pilot application of a targeted roadmap created as a part of an umbrella model showed that this methodology can be adapted for corporate IDP and national S&T Foresight needs in Russia and other countries. Moreover, it fully corresponds to the tasks of analysis in a fast-moving highly competitive environment in priority technological fields.

Umbrella roadmap facilitates the innovation process in fast evolving domains where the most important challenge is to construct an up-to-date roadmap due to the frequency and wide impact of changes. In the 5 generation innovation model where resource and time constraints define the success of decision-making process umbrella roadmap system can become an useful methodological tool for the efficient management of time, financial, human and other sorts of resources. A complex umbrella roadmap contains general trends, major challenges and opportunities, the list of products/services, markets, and major scenarios. An umbrella roadmap created once for a particular project with many research fields united by the one theme (industry foresight, corporate foresight etc.) become a framework for several targeted roadmaps for which there is no need to carry out difficult, cost- and time-consuming full-scale, in-depth research about general trends, common (for industry or company) challenges and opportunities etc. Targeted roadmaps can be devoted to the detailed analysis of fast-changing technologies/products/markets. Moreover a process of an umbrella roadmap system development is very flexible and tunable; it can be either top-down (starting with an umbrella) or bottom-up (starting from targeted roadmaps). Also one more advantage of the proposed methodological instrument is that it lets you make targeted roadmaps for different planning periods by aggregating individual roadmaps into an integrated one.

Developed methodological approach was tested on the pilot project (the Russian case study), but we understand that the proposed

model needs to be studied and tested on other areas. It is necessary to adapt algorithms and formats used in our umbrella pilot application to different Foresight cases that may be prepared for various industries, companies and at each level (national, regional, and corporate). In order to further develop, extend, and validate the applicability of our suggested general umbrella roadmap framework and targeted roadmaps system, it would be useful to apply an umbrella roadmap system within the research for Foresight 2040 (currently underway) in Russia that looks at the medium- and long-term forecasts of disruptive technologies' trends, products, and markets. According to our estimates the methodological approach described in this paper accompanied with a fine-tuning has a great potential to be implemented in wide range of application fields.

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