Methodical Approach to Estimation of Effectiveness of the Radio Frequency Monitoring System

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Abstract: ***The methodical approach and indicators of the estimation of the efficiency of work and using of different types of radio monitoring equipment (SRK) (RME) in the complex solution of the production and technical tasks of radio monitoring of the regulatory using of the radio frequency resource (RFR) are substantiated. The approach is based on the system methodology of space-frequency-time estimation of the efficiency of the functioning of the national radio frequency monitoring systems (RFMS) and the performance and production capacity of the RME, taking into account the technological process of radio monitoring, proposed by the authors. The results of estimation based on the experimental data of the productivity of the entire RME national RFMS park of common RFR users and the efficiency of their operation and use are used for the example of the work of the regional subsystem of radio frequency monitoring system (RSS RFMS) for the quarter. Recommendations are given on the practical application of the developed evaluation indicators and the methodical approach as a whole.***

Keywords: radio frequency monitoring, radio frequency resource, radio monitoring means, radio technologies, productivity, production capacity, efficiency.

1. Introduction

Due to the rapid technological development of radio electronic equipment in the world, the introduction of new radio technologies and the increase in the number of radio electronic devices (RED), the problem of controlling the parameters of the emissions of such means in the frequency bands of the national RFR allocated to them is acute. The most important and most effective tool in ensuring control over the use of RFR, the legality of the operation of RED and their electromagnetic compatibility are the national radio frequency monitoring (RFMS) systems. Regional radio frequency monitoring subsystems (RSS RFMS), as components of the RFMS, solve the tasks of collecting, processing, analyzing and storing data on signal parameters and radiation characteristics of RES for the purpose of generalizing and evaluating the real state of HRD use [1, 2].

At the present time in Ukraine, automated RFMS has been created with the use of new scientific achievements in the field of engineering and information technologies [3-9]. It is one of the most powerful in Europe in terms of RME composition and quantity, the level of automation and the scale of coverage of the national RFR in the territory and consumers of various radio technologies in the telecommunications sector. Thus, a stationary component of the current topology of the RFMS covers a territory with a total population of more than 34 million people. and 74% of RED from their total in the frequency band from 30 MHz to 6 GHz. With the application of mobile components, over 98% of GSM900, GSM1800, CDMA800, UMTS base stations and 76% of base stations of broadband radio access in the frequency band from 30 MHz to 6 GHz and more than 75% of the RED in the bands are covered by radio monitoring. frequencies from 6 GHz to 40 GHz.

Estimation of the effectiveness of the functioning of such a complex RFMS as a material and technical basis for regulating the use of the RFR, with a view to determining the directions for its further improvement, is a problematic task. In [1, 2] the methodology, a unified system of indicators and a methodological apparatus for evaluating the effectiveness of the functioning of national RFMS are presented on the basis of a system analysis of complex systems and the proposed space-frequency-time approach. Sources of information in the developed scientific and methodical apparatus are the radio monitoring equipment. However, in these works, the questions of estimating the basic indicators of RME, such as productivity and production capacity, are not specified. Based on these indicators, it is possible to evaluate the efficiency of using and work of RME, which determine the effectiveness of the RSS RFMS and RFMS as a whole. This task is relevant for radio-frequency departments of different levels and purposes.

The purpose of the article is to substantiate the methodical approach to assessing the performance indicators of the efficiency and using of the RSS RFMS and to present the results of their calculation (when using different types of RMS). The analysis of calculation results for optimization of quantitative and qualitative composition of RME in the RSS RFMS is done.

2. Main Part

By the efficiency of the operation of RME, we mean the ratio of quantitatively pronounced results obtained with the given RME for a given period of time, to potential or maximum possible over the same period.

The effectiveness of the functioning of the RME largely depends on its functional and technical capabilities, which determine their productivity and production capacity in solving the main tasks of radio monitoring [1]. Productivity and production capacity are sufficiently universal technical indicators and allow to track the results of production activities. In general, productivity and production capacity are extrasystem variables, determine the amount of work performed or the quantity of products produced, respectively,

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per unit time or for a certain period and depend on the radio monitoring process [3].

In accordance with the deterministic space-time-frequency approach to assessing the effectiveness of the functioning of the RFMS [1], the productivity of the RME in its general form is determined by the expression

$$\mathrm{P} = \Delta S_k \cdot \Delta F_k \cdot (\Delta T_k / T), \qquad (1)$$

where ΔS_k, ΔF_k u ΔT_k - controlled territory, frequency range and control time; T - period of time (hour, shift, day).

Then the production power of the RME can be estimated as

$$\pi = \mathrm{P} \cdot T^{sch.m} \qquad (2)$$

where $T^{sch.m}$ - scheduled time of radio monitoring (month, quarter, year).

The technology of using RME in the process of radio monitoring depends on the monitored radio technology, the nature of the tasks being solved, the level of automation of their solution and the qualification of operators.

In accordance with [3, 4], the Government Offering "Ukrainian State Center of Radio Frequencies" carries out scheduled periodic (monthly) technical monitoring of emissions of REDs $j = 23$ civil purpose radio technologies for $T^{sch.m}$ = 21 working days with a working shift of 8 hours with the provision of monthly and consolidated quarterly electronic reporting for $3T^{sch.m}$ = 63 working days. At the same time, the following radiomonitoring tasks are solved with quantitatively expressed results:
- z = 1 - control of the compliance of the parameters of emissions of registered RED to regulatory documents;
- z = 2 - monitoring the employment of radio frequency bands;
- z = 3 - identification of illegally operating transmitters (IOT);
- z = 4 - identification of sources of radio interference (SRI).

To solve them, a set of stationary, mobile and transportable (portable) RMEs, including k = 14 types, is completely or partially used in the RSS RFMS. These types of RME are presented in Table 1 with an indication of their purpose and degree of mobility according to [3]. Detailed technical characteristics of these RME can be found in the reference books on radio monitoring [4-6] and on the websites of manufacturers.

A fairly wide range of used RME is due to their targeted applications for solving various types of tasks on different types of radio technologies, requiring a different number of operations and different methods of monitoring. As a result, the productivity and production capacity of the same RME in the solution of different tasks and the monitoring of the radiations of RED different radio technologies will be different.

Table 1: List of used radio monitoring equipment

№ (*k*)	Tipe of RME	Purpose of equipment	Mobility
1	PM-172	Detection and technical radio monitoring (DTRM)	Stationary
2	PM-2500P	General purpose	
3	АИК-С		
4	АИК-СП(СП6)	DTRM	
5	UMS-100		
6	PM-1300 XX	General purpose	Mobile
7	PM-1300-2P3		
8	PM-1300-P3/5	Specialized	
9	PM-1300-P3/5M		
10	Romes-3NG	DTRM	Transportable
11	Нагляд А6		
12	«Anritsu»	Spectrum analyzers	
13	«Advantes»		
14	ССТК	Measuring laboratory	Mobile

In this connection, it is advisable to use the breakdown of radio technologies proposed in [3] into classes (groups), the monitoring of the emissions of RED of which can be provided by the same type of RME. These classes include:

j = 1 - traditional radio technologies (analogue television and sound broadcasting, trunking and analogue VHF radio communication, data transmission, etc., total $I_1 = 12$), for radio monitoring of which stationary RME are intended in their electromagnetic accessibility (EMA) zones and mobile general-purpose RME outside EMA zones of stationary RME;

j = 2 - radio technologies for GSM, CDMA, UMTS, DAMPS and DECT ($I_2 = 4$) cellular radio technologies, for monitoring of which, specialized mobile RME with radio channel identifiers of base stations have been developed;

j = 3 - radio technologies for broadband, multimedia and multiservice radio access ($I_3 = 2$), for monitoring of which mobile stations Romes-3NG and Нагляд А6 are transported by mobile means;

j = 4 - radio technologies of radar and radio navigation, radio relay, satellite and HF radio communication ($I_4 = 5$), for monitoring of which used spectrum analyzers are transported by mobile means.

However, due to many factors (geographic, economic, temporal), RME is really used in a complex way for radio monitoring of several classes of radio technologies. So, in particular, in order to save material and time resources, mobile RME, following the developed route, control the emissions of RED, relating to the first and second class of radio technology. At the same time, the productivity of mobile RME on these radio technologies will be different. In addition, during the period of planned monitoring $T^{sch.m}$, certain types of RME can participate in the solution of not all, but only part of the tasks of radio monitoring.

In view of the foregoing and in accordance with (1) the average (generalized) for problems and classes of radio technologies, the productivity of the *k-th* type of RME in a cer-

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tain space-time-time continuum can be represented as a matrix of size $(Z \times J = 4 \times 4)$:

$$\mathrm{P}_k = \sum_{z=1}^{Z}\sum_{j=1}^{J} \rho_{kzj} \frac{\Delta S^{\kappa}_{kzj} \cdot \Delta F^{\kappa}_{kzj} \cdot \Delta T^{\kappa}_{kzj}}{T} = \sum_{z=1}^{Z}\sum_{j=1}^{J} \rho_{kzj} \cdot \mathrm{P}_{kzj}, \quad (3)$$

where ρ_{kzj} - is the weight coefficient of importance of the solution of the z - th monitoring task of RED related to the j-th class of radio technologies, and $\sum_{z=1}^{Z}\sum_{j=1}^{J} \rho_{kzj} = 1$;

P_{kzj} - the private productivities of RME for the corresponding task and class of radio technologies;

$\Delta S_{kzj} \cdot \Delta F_{kzj} \cdot \Delta \mathrm{T}_{kzj}$ - space-frequency-time continuum, including the zone of EMA RED, controlled frequency range and time of their control.

The average (generalized) productivity of the RME can be used to optimize the coverage of the RED radiations of the various radio technologies in the control zone over the frequency range and the time expenditure.

The actual productivity of the RME depends on the number (density) of the RED in the controlled area, the density of operating frequencies in the controlled range, the task execution time and the selected period of time.

Radiomonitoring is a complex process, influenced by many deterministic and random factors, which, in turn, affects the duration of individual operations of radio monitoring. For their statistical averaging, it is advisable, in accordance with normative document [3], to select the directive period of time $T = T^{\mathrm{sh}}$.

We take into account the distribution density of the RED of the monitored groups of radio technologies across the territory within the EMA zone and in the frequency range. These values can be obtained on the basis of a preliminary analysis of the radio-electronic environment of the controlled zone or region according to the database of frequency assignments. At the same time, the relative parts of controlled radio electronic equipment for work shift can be defined as

$$N^{\kappa}_{zj} = \int_{\Delta S_k} p_j(x,y)dxdy \int_{\Delta F_k} p_j(\Delta f)df .$$

Accordingly, the partial productivity of the RME for the corresponding task and radio technology in (3) will be described by expression

$$\mathrm{P}_{kzj} = N^{\kappa}_{j} \cdot \Delta T_{kzj} / T^{\mathrm{sh}} . \quad (4)$$

When expression (4) determines the potential productivity P^{p}_{kzj} of the k-th type of RME when performing the z-th task for RED of j-class radio technology for the working shift. It should be taken into account that in the practical use of RME, there are always both productive and non-productive expenditures of time, i.e.

$$\Delta T_{kzj} = \Delta T^{\mathrm{pr}}_{kzj} + \Delta T^{\mathrm{npr}}_{kzj} . \quad (5)$$

Having determined the productive and non-productive expenditure of time, it is easy, in accordance with (4), to find real productivity for the same conditions. The real productive of each type of RME for monitoring emissions of RED of the j-th class of radio technologies for the work shift in the solution of the first two tasks is used in the calculation methodology of the monitoring efficiency of the RSS RFMS and the RFMS as a whole [1, 2].

Taking into account, that for the planned period RME of the k-th type can fulfill all tasks and carry out the radio monitoring of the radiations of the RED of all radio technology groups, we can find its generalized real and potential production capacities by substituting (3) in (2)

$$\pi_k = \sum_{z=1}^{Z}\sum_{j=1}^{J} \rho_{kzj} \cdot \mathrm{P}_{kzj} \cdot \mathrm{T}^{sch.m}_{kzj}, \quad (6)$$

where $\mathrm{P}_{kzj} = \mathrm{P}^{r}_{kzj}$ or P^{p}_{kzj}, calculated by expression (4);

$\mathrm{T}^{sch.m}_{kzj}$ - number of working shifts for the implementation of the z-th task on the monitoring of emissions of RED of the j-th class of radio technology.

Then the indicator of the efficiency of the operation of the RME of the k-th type to solve all or part of the tasks and to control all or part of the radio technologies can be determined from the ratio of the real and potential production capacities

$$\mathrm{E}^{sch.m}_{kzj} = \pi^{r}_{k} / \pi^{p}_{k}, \quad (7)$$

where π^{r}_{k} and π^{p}_{k} - respectively, the real and potential production capacity.

In this case, the criterion of efficiency is the condition $\mathrm{E}_k \ge \mathrm{E}^{mp}_{k}$, where E^{mp}_{k} - the required efficiency of production capacity.

For many reasons of objective and subjective nature (malfunctions of control equipment and vehicles of mobile RME, the redundancy of some types of RME, insufficient qualification of maintenance personnel, etc.), some types of RME can not to be used for performing radiomonitoring tasks for the whole planned period $T^{sch.m}$. To identify specific reasons for this, it is advisable to introduce a criterion of efficiency of RME. As such an indicator is proposed a coefficient (efficiency index) of the using of the existing RME park.

$$\mathrm{E}^{\mathrm{u}}_{k} = \sum_{z=1}^{Z}\sum_{j=1}^{J} \mathrm{T}^{\mathrm{sch.m}}_{kzj} / \mathrm{T}^{\mathrm{sch.m}} \quad \text{and} \quad \mathrm{E}^{u}_{k} \ge \mathrm{E}^{u.mp}_{k} \quad (8)$$

Estimation of productivity indicators (4) and effectiveness indicators (7), (8) is of great practical importance. Using indicator (4) makes it possible to perform a comparative analysis of the capabilities of all types of RMEs in the efficiency of solving each task and radiomonitoring the RED of each radio technology group. With the help of the indicator (7), it is possible to estimate the efficiency of each RME in the RSS RFMS for the planning period. Indicators sharing

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(7) and (8) allows to develop directions for improving (optimizing) the structure of the RSS RFMS (composition, type, location of stationary and routes of mobile RME).

Let's demonstrate the practical focus of the stated methodical approach to assessing the efficiency of the operation and using of the existing RME park in the regional subsystems of the national RFMS of common RFR users.

From (5) it follows, that it is necessary to determine and calculate the productive and non-productive time spent in performing RME tasks of radiomonitoring. In accordance with [4], together with the specialists of the Government Offering "Ukrainian State Center of Radio Frequencies" it was determined that the total unproductive time expenditure includes:

ΔT^{st} - the time for setting of tasks to shift operators;
ΔT^{kf} - time for control of the function of the RME;
ΔT^{mov} - time of movement to the place of execution of radiomonitoring;
ΔT^{dep} - the time for the deployment/closing-down of RME;
ΔT^{fp} - time for final processing of radiomonitoring results.

Taking into account the technology of using RME, the inefficient time spent for stationary, mobile and portable RMEs will differ. Non-productive time expenditure for stationary RME are calculated as

$$\Delta T_{kzj}^{\text{npr st}} = \Delta T_{kzj}^{st} + \Delta T_{kzj}^{\text{kf}} + \Delta T_{kzj}^{\text{fp}} . \qquad (9)$$

Non-productive time expenditure for mobile and portable RME are determined by the following time parameters.

$$\Delta T_{kzj}^{\text{npr mob}} = \Delta T_{kzj}^{st} + \Delta T_{kzj}^{kf} + \Delta T_{kzj}^{fp} + \Delta T_{kzj}^{mov} + \Delta T_{kzj}^{dep} \qquad (10)$$

It should also be taken into account that not all mobile RME need to deploy equipment on the ground and can perform the necessary functional operations in automatic mode while driving. In this case, time $\Delta T_{kzj}^{dep} = 0$.

To the productive time expenditure for control of radiation from a single RED by stationary, mobile and portable RME were carried:
ΔT_{kzj1}^{co} - time for performing radiation control operations;
$\Delta T_{kzj1}^{\text{fp}}$ - time for the formation of an electronic measurement protocol;
ΔT_{kzj1}^{ip} - time for the initial processing of the results.

Accordingly, the total productive costs of time for all types of CPC are equal

$$\Delta T_{kzj1}^{\text{pr}} = \Delta T_{kzj1}^{\text{co}} + \Delta T_{kzj1}^{fp} + \Delta T_{kzj1}^{\text{ip}} . \qquad (11)$$

For carrying out the corresponding calculations, timekeeping of productive and non-productive time expenditure in accordance with (9-11) was carried out in one of the RSS RFMS. In Table. 2, for example, statistically averaged results of measuring the indicated time expenditure for the solution of the first task, given by the above types of RMEs. At the same time, different types of RMEs are grouped in the table, which monitor the emissions from RED of equal classes of radio technologies. The total productive time $\Delta T_{k1j1}^{\text{pr}}$ spent on solving the first task during the shift T^{sh} is determined based on Table. 2 by expression (5).

Similar estimation and calculation of productive time was spent on the performance of radio monitoring operations for different types of RME in solving the second task ($z = 2$).

When performing the RME of the tasks $z = 3$ and $z = 4$, there are a number of factors that make it difficult to estimate the productive time expenditure:

- Periodicity of radiomonitoring;
- A priori uncertainty regarding the operating time, the frequency characteristics of the radiation and the location of the iot and the sri;
- The need to attract 2 or 3 fixed and/or mobile rmes to determine the location of the iot or the sri.

These factors significantly increase the productive time expenditure for identifying IOT and SRI, which can range from several hours to several shifts. In this connection, based on the statistical averaging of the results of the solution of these tasks by RSS RFMS, for the reporting periods was determined that potentially in the working shift two RME could reveal one IOT or one SRI.

In Table. 3 shows the real and potential RME productivity estimates for the working shift for $z = 1$ and $z = 2$ and all classes of radio technologies ($J = 4$), taking into account the technological process of their radiomonitoring, calculated using the expression (4) from the obtained data of productive and non-productive time expenditure. Potential RME productivity for the tasks $z = 3$ and $z = 4$ are determined on the basis of the above considerations, and the real ones are based on the results of the identified IOT and SRI.

Estimates of real productivity illustrate the capabilities of each type of RME for radiomonitoring of emissions of RED for a work shift for each task and class of radio technologies. Note, that the classes of radio technologies include in their composition all $I = 23$ types, operated on the territory of Ukraine. It follows from the table that non-productive time expenditure processes, which are unavoidable for the technological process of radio monitoring, reduce the real productivity of RME by 15-25% compared to the potential one.

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Table 2: The results of timing the productive and non-productive time, spent on the first task for the shift work

	Types of RME	PM-172 PM-2500P АИК-С АИК-СП (АИК-СП6)	UMS-100	PM-1300 XX PM-1300-2P3 PM-1300-P3/5 PM-1300-P3/5M		Romes-3NG Нагляд А6	«Anritsu» «ADVANTEST»	CCTK	
	Classes of radiotechnologies	j=1	j=1	j=1	j=2	j=3	j=4	j=1	j=4
The productive expenditure of time	ΔT^{co}_{k1j1}, min.	25	60	10	12	33	33	22	22
	ΔT^{fp}_{k1j1}, min.	5	10	4	4	27	27	15	15
	ΔT^{ip}_{k1j1}, min.	5	10	10	10	10	10	10	10
	Total, ΔT^{pr}_{k1z1}	40	80	24	26	63	63	47	47
Non-productive time expenditure	ΔT^{st}, min.	40	40	60	60	40	40	45	45
	ΔT^{kf}, min.	10	10	10	10	10	10	10	10
	ΔT^{mov}, min.	0	0	45	45	40	40	45	45
	ΔT^{dep}, min.	0	0	0	10	10	10	30	30
	ΔT^{fp}, min.	10	10	15	15	15	15	15	15
	Total ΔT^{npr}_{kzj}	60	60	130	130	115	115	145	145

Table 3: The results of calculating the real and potential productivity of RME in tasks for a shift

	Types of RME	PM-172 PM-2500P АИК-С АИК-СП (АИК-СП6)	UMS-100	PM-1300 XX PM-1300-2P3 PM-1300-P3/5 PM-1300-P3/5M		Romes-3NG Нагляд А6	«Anritsu» «ADVANTEST»	CCTK	
	Classes of radiotechnologies	j=1	j=1	j=1	j=2	j=3	j=4	j=1	j=4
z=1	P^{r}_{k1j}	12	5	15	13	6	4	6	7
	P^{p}_{k1j}	14	6	20	18	8	6	8	10
z=2	P^{r}_{k2j}	12	6	34	8	5	5	8	4
	P^{p}_{k2j}	14	8	39	10	7	7	10	6

Table 4: Number of shifts in the work of the RME in the analyzed RSS RFMS for the reporting period

Tasks of the radiomonitoring	Serial number of RME													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Z=1	24	21	24	24	10	45	45	42	48	42	42	42	42	42
Z=2	24	21	24	24	10	9	6	6	9	8	8	6	9	6
Z=3	3	3	3	3	0	3	3	3	3	3	3	3	3	3
Z=4	3	3	3	3	0	3	3	3	0	3	3	3	3	3
Total	54	48	54	54	20	60	57	54	60	56	56	54	57	54

Since the generalized reporting period for the work of the RSS RFMS and RFMS generally is a quarter, the production capacities and the efficiency of the operation of the various types of RME should be evaluated for the given period. Based on the analysis of quarterly electronic reporting, it was revealed that in different RSS RFMS, the number of shifts in the use of the same RME for performing the same tasks may differ significantly. This is due to the different number of registered REDs in the regions and the different configuration of the RME park in the RSS RFMS. Therefore, despite the same productivity, the production capacity and efficiency of the RME will be different from region to region.

In order to obtain the final result on the proposed methodological approach, we will conduct an example of an assessment of the efficiency of the using and operation of the whole RME park one of the RSS RFMS for all radiomonitoring tasks for the first quarter of year. In Table. 5 shows the reporting data of shifts in the work of the RME for each task and for the entire period.

Taking into account the directive working time for the quarter $3T^{sch.m}$ = 63 shift workers according to the expression (8) and the data in table 4, it is easy to estimate the efficiency of the use of RME for the specified period. According to the productivity of the RME (table 3) and the number of shifts RME for the quarter (table 4), based on the expressions (6), (7), the production capacity and efficiency of each type of RME for the quarter can be estimated accordingly.

In table 5 presents the results of the assessment of the efficiency of the operation and using of the RME park one of the RSS RFMS for radiomonitoring the emissions of RED

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in 23 radiotechnologies in the quarter (under review). The received results testify to rather high efficiency of operation and using of all RME, except URS-100, whose low values are due to the small EMA zone due to low sensitivity.

Table 5: Efficiency of operation and efficiency of using of the RME in the studied RSS RFMS

S/N	Indicators / RME	π_k^r for the quarter (units)	π_k^p for the quarter (units)	$E_{kzj}^{sch.m}$	E_k^u
		Z=4	Z=4	Z=4	Z=4
1	PM-172	594	677	0.86	0.86
2	PM-2500P	605	720	0.84	0.76
3	АИК-С	696	790	0.83	0.86
4	АИК-СП (СП6)	696	790	0.83	0.86
5	UMS-100	120	280	0.87	0.42
6	PM-1300 XX	1657	2184	0.76	0.95
7	PM-1300-2P3	1578	1940	0.77	0.91
8	PM-1300-P3/5	1494	1836	0.76	0.76
9	PM-1300-P3/5M	1957	2115	0.92	0.95
10	Romes-3NG	608	780	0.77	0.89
11	Нагляд А6	608	780	0.77	0.89
12	«Anritsu»	490	606	0.80	0.86
13	«Advantes»	515	650	0.79	0.91
14	ССТК	618	745	0.82	0.86

A similar quarterly assessment of the effectiveness of the operation and using of RME was carried out for all 26 RSS RFMS for the national RFMS of the general users of the RFR. The analysis of the obtained results made it possible to identify the problematic aspects of the using and bundling of RME in the RSS RFMS and to plan the measures to optimize their qualitative and quantitative composition.

These results were also used to estimate, in accordance with the methodology [1], for each RSS RFMS of the production and integral efficiency indicators of using for each task, the radio monitoring of each class of radio technologies, the radio monitoring process for stationary, mobile components and the entire subsystem. On the basis of their analysis, recommendations were developed and justified on the further improvement of the RSS RFMS and RFMS in general.

3. The Conclusion

The article presents a developed methodological approach with a unified system of indicators for assessing the production capacity and efficiency of the operation RME on radio monitoring of the regulatory use of national radio resources by registered RED.
The methodical approach is based on the system methodology proposed by the authors of the space-time-frequency estimation of the effectiveness of the functioning of national RFMS [1]. It is applicable for assessing the effectiveness of the operation and the use of RMEs by radio-frequency organs, both general and special purpose, taking into account the specific features of their operation.

In general, the practical focus of the proposed methodological approach to assessing the effectiveness of the operation and the using of RME is to improve of the planning and radio monitoring process.

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