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PROPOSED AMENDMENTS TO ANNEX 1 – MONITORING SYSTEM PLANNING AND TENDERS OF THE ITU HANDBOOK ON SPECTRUM MONITORING

Introductory remarks

Annex 1 of the ITU Spectrum Monitoring Handbook, 2011 edition, which deals with monitoring system planning and tendering, holds a prominent position in the Handbook. The monitoring subsystem is the costliest part of the entire spectrum management system; therefore, optimizing the process of establishing such a subsystem is crucial. Thus, improving the text of Annex 1 is an actual task.

The proposed enhancements include:

- supplementing the text with useful provisions of a broadening or explanatory nature;
- adding references to two recent publications on spectrum monitoring networks planning in the HF frequency range, as this information appears to be absent from ITU documentation;
- significant expanding the references to other ITU documents which provides more information on the topics discussed in Annex 1;
- creation of the list of ITU documents referenced in the Annex, similar to other sections of the Handbook.

Attachment: 1

PROPOSED AMENDMENTS TO ANNEX 1

Monitoring system planning and tenders

Editor's note №1. Amend section A1 as follows:

A1 Topics to be considered by Regulatory Authorities before issuing a tender

A National Radio Regulatory Authority has to interpret and implement the provisions of the ITU RR, which have the force of international treaty. It has also to implement the national statutory provisions of the national laws and the Rules framed there under, relating to radiocommunications. Compliance of the provisions of the authorisations/ licenses by various wireless users spread all over the country has also been enforced. Monitoring Organization is the field Organization of the national Authority providing practical data as relevant for spectrum management including control and regulation of wireless networks with a view to ensuring interference-free operations of all networks.

The Monitoring Organization is entrusted with all necessary responsibilities for effecting coherent and extensive usage of radiocommunications in the country. Following aspects relate to planning, coordination and regulation of the spectrum in the national context:

- a) optimising the utilisation of radio spectrum by following the latest international standards and practices for spectrum management and wireless monitoring functions;
- b) utilisation and protection of orbit/frequency resource for national satellite and other space systems by publishing, notifying and registering national system with ITU and ensuring continued protection from new systems of other countries;
- c) identifying the spectrum need for new wireless networks, and assigning to them suitable frequency(ies), power, bandwidth, emission, hours of operation, and other technical parameters with appropriate operational, regulatory and administrative provisions;
- d) authoring the installation and operation of wireless stations by specifying all the necessary technical and operational parameters like frequency of operation, power, emission, hours of operation, etc.;
- e) establishing regulations, technical parameters and standards governing the use of each frequency band or specific frequency by stations of different radio services, having regard to current international regulation and agreements;
- f) undertaking special coordination work for use of radio systems/equipments in special situations such as natural calamities, etc.;
- g) maintaining and updating all information on authorized radiocommunication systems such as frequencies, locations of stations, power, call signs etc.

The main provisions concerning spectrum management are set out in the ITU-R Handbook on National Spectrum Management, which also provides links to relevant ITU-R Recommendations and Reports.

Radio Monitoring supports all these functions as it is an important part of spectrum management process. It plays a significant role in the planning, engineering, electromagnetic compatibility and in ensuring compliance with licensed/authorized parameters. In fact the monitoring is known as eyes and ears of spectrum management. *The tasks and basic requirements for radio monitoring are set out in Chapter 1 of this Handbook on Spectrum Monitoring (further referred as the "Handbook"), as well as in Recommendations ITU-R SM.1050, ITU-R SM.1392 and ITU-R SM.2039.*

The other Chapters of this Handbook ~~on Spectrum Monitoring~~ provide many detailed descriptions of all types of monitoring stations, equipment and procedures. [They also contain links to relevant ITU-R Recommendations and Reports](#). This Annex provides an overview about what sort of planning, studies and procedures are required when developing either a nation-wide monitoring system or a fixed or mobile monitoring station. [Useful information on this issue is also provided in the ITU-D Guidelines](#).

Radio frequency spectrum is to be used equitably, economically, efficiently and rationally. Appropriate frequency repeatability is therefore required to be ensured. Adoption of appropriate equipment and monitoring system required to be ensured.

Editor's note №2. Sections A2 and A3 (beginning of Section) – no change.

Editor's note №3. Amend sections A3.1 to A3.2.1 as follows:

A3.1 Concept for a radio monitoring system

As described in Chapter 1 of this Handbook, Spectrum Management is described as the overall process of regulating and administering use of the radio frequency spectrum. The goal of spectrum management is to maximize spectrum efficiency and minimize interference. Rules and regulations, based on relevant legislation, form a regulatory and legal basis for the spectrum management process. Databases of information, including details of all authorized users of the spectrum, provide the administrative and technical basis for the process. Analysis of the information in these databases facilitates the spectrum management process resulting in decisions for spectrum allocations, frequency assignments, and licensing. Amongst others spectrum monitoring provides the necessary means to maintain the integrity of the spectrum management process and can be defined as a process of observing the radio frequency spectrum and reporting on its use. [Automation and integration of a radio monitoring system with an automated spectrum management one is presented in Recommendation ITU-R SM.1537](#). Issues related to the participation of the planned spectrum monitoring system in the ITU international monitoring system are also subject to consideration (§ 1.4 of this Handbook, as well as Recommendations ITU-R SM.1139 and ITU-R SM.1394).

In defining the operational concept, the following elements need to be addressed:

- Automation of data management and spectrum monitoring process, with appropriate computer software. The computer software and equipment for spectrum monitoring activities are specialized [as it follows from the ITU-R Handbook on Computer-aided Techniques for Spectrum Management \(CAT\) and Chapter 3 of this Handbook](#). Consequently provision of adequate materials would be essential for these activities.
- Augmentation of automated spectrum monitoring, radio noise surveys, and direction finding facilities, both in the fixed and mobile modes (capabilities up to ~~3~~-6 GHz) (§§ 3.6 and 5.7 of this Handbook).
- If the planned network provides monitoring stations in the HF frequency range, special attention should be paid to determining the number of such stations and their placement throughout the country. This is caused by the specific operating conditions of HF monitoring stations due to ionospheric propagation of radio waves, which requires special approaches. Useful and sufficiently detailed information on the planning and operation of HF radio monitoring networks is provided in publications 1 and 2.
- Specialized monitoring facilities for sound and television broadcasting, including measurements of radio coverage areas (§§ 5.2 and 4.11 of this Handbook, as well as Recommendations ITU-R SM.1792 and ITU-R SM.1875 and Report ITU-R SM.2504).

- Specialized monitoring facilities for cellular mobile communication systems, including measurements of the relevant coverage areas (§§ 5.3 and 4.11 of this Handbook, as well as Recommendation ITU-R SM.1447).
- Specialized monitoring facilities for microwave and other higher frequency bands and for specialized services up to 50 GHz or above (§§ 5.4 and 5.5 of this Handbook, as well as Recommendation ITU-R SM.1754 and Report ITU-R SM.2304).
- Augmentation of satellite monitoring facilities for geostationary (GSO) and non-geostationary (non-GSO) satellite systems if this is specified by the planned spectrum monitoring system (§ 5.1 of this Handbook, Recommendations ITU-R SM.1054 and ITU-R SM.1681, Reports ITU-R SM.2182, ITU-R SM.2424 and ITU-R SM.2453).
- Special provisions concerning equipment for measuring non-ionizing radiation in the interests of preventing health hazards caused by electromagnetic radiation (§ 5.6 of this Handbook and Report ITU-R SM.2452).
- The use of drones for spectrum monitoring purposes (*a new item in a future version of this Handbook* and Report ITU-R SM.2486).
- The use of spectrum monitoring facilities in the interests of the inspection of radio installations (§§ 2.1.1.3 and 2.1.1.4 of this Handbook, as well as Reports ITU-R SM.2130 and ITU-R SM.2156).
- Structure of the organization (staff) and its interaction with other organizations particularly by the spectrum management (*Chapter 1 of this Handbook and Recommendation ITU-R SM.1537*).
- Existing and required infrastructure (*Chapter 2 of this Handbook*).
- Training of personnel for institutional competence and capacity building (*Chapter 2 of this Handbook*); etc.

These elements are addressed in the following sections.

Once the operational concept has been defined, a cost/benefit analysis should be conducted to assess whether the requirements of the administration would be met in a cost effective way. This is always necessary, no matter whether a new system or the modernization/modification of an existing system is planned.

A3.2 Feasibility study

A3.2.1 The goal of feasibility study

The feasibility study, within the financial and human resources available for this purpose, is a fundamental basis of starting a tender process. The study is needed in order to analyze alternatives, study the impact of developments on the future measurement possibilities and find the best solution, including what would be the impact on the spectrum management responsibilities in case one decides not to procure new equipment.

The study should also answer the question on what the achievable advantages of the technical development are for the authority, the information society and the spectrum users?

During the development of technical planning of monitoring measuring devices or systems, one should take into consideration the technical capability, the lifetime and deterioration of the available devices or systems.

In the course of the planning and development of measurement devices or systems, the following items should be specified and taken into consideration:

- Coverage areas of monitoring based on:

- i) responsibilities of the Regulatory Body;
 - ii) size of the country;
 - iii) density of the spectrum usage over the country;
 - iv) need for other functional elements of the spectrum management process, such as frequency planning, licensing and enforcement departments;
 - v) responsibility of the monitoring service;
 - vi) future planned use of radio communication in the country.
- Measurement tasks derived from the regulatory environment.
 - Technical specification(s) of the equipment related to the tasks.
 - Need for a comprehensive measuring system or for a specially designed measuring system for performing a special type of measurement.
 - Number and location of (remote) fixed stations.
 - The functions of mobile **and transportable** monitoring units.
 - Number and type of mobile **and transportable** units.
 - Purchase of a turn-key system or build-up a system from individual components.
 - Integration into an existing system or purchase of a stand-alone system.
 - Necessity of remote access to the measurement and/or frequency management data bases.
 - Degree of dependence from a single supplier.
 - Price of equipment and **follow-up-related** cost.

The depth of feasibility studies and the cost for external contributors should be proportional to the value of the investment.

Editor's note №4. Sections A3.2.2 to A3.5 (title of section) – no change

Editor's note №5. Amend sections A3.5.1 as follows:

A3.5.1 Planned spectrum monitoring network, ~~N~~national and regional centres, monitoring stations

In accordance with Recommendation ITU-R SM.1392, when planning a spectrum monitoring system, special attention should be paid to the required number of monitoring stations, the choice of their locations, as well as their remote control. The main provisions on optimizing the placement of monitoring stations in the network are given in § 6.8 of this Handbook and detailed guidance on this topic is provided in Report ITU-R SM.2356.

The requirements for the placement of monitoring stations in terms of their protection from powerful radio transmitter emissions and from the environmental impact are presented in § 2.6 of the Handbook and in Recommendation ITU-R SM.575. Detailed information on remote control of monitoring stations is given in § 2.5 of the Handbook.

Administrations in smaller countries tend to have a national monitoring centre and an appropriate number of fixed and/or mobile monitoring stations, which are controlled directly by the national monitoring centre. Administrations in larger countries may find it desirable to have regional monitoring centres in addition to the national centre. In either case, the national monitoring centre may also include a national spectrum management centre to provide integrated automated management and monitoring of the radio spectrum.

The mobile monitoring stations (§ 2.4.2 of this Handbook and Recommendation ITU-R SM.1723) supplement the network of fixed stations although they are indispensable for the purpose of finding sources of radio emissions (including interfering and illegal ones) directly in their locations.

Practically ~~they~~ mobile stations have the same measuring capabilities like fixed station, but can be installed easily almost anywhere in the country, accordingly are able to monitor different spots. At the same time, it should be taken into account that the operation of mobile stations is more time-consuming and financially costly.

In compliance with their functions, certain mobile monitoring stations (vans for interference investigation, coverage measurement, measurement of microwave networks) possess specialized measurement capabilities. The issues of using transportable stations (§ 2.4.3 of this Handbook) should also be considered.

For specifying their types and necessary number, effort should be made to achieve their most optimal building-up and measurement capacity, in the course of planning stage. Considerations on the optimal number of mobile stations relative to fixed ones are given in Report ITU-R SM.2356.

In case of mobile stations, the expectable frequency of measurement tasks should be taken as a basis in the first place when specifying their necessary number.

During the planning of measurement system capacity, the necessary number of fixed stations depends on the size and the terrain conditions of the area, as well as the frequency range that must be monitored.

When designing a mobile monitoring station, a compromise must be found between full-scale equipment, budget and limitations on weight and space of the vehicle. Therefore, it must be decided whether a general-purpose vehicle or a specialized vehicle for the certain task should be procured.

The available service network and spare part supplies for the applied vehicles in the country are also important viewpoints.

Editor's note №6. Section A3.5.1.1 – no change

Editor's note №7. Amend section A3.5.1.2 as follows:

A3.5.1.2 Measurement tasks

It should be noted that it is up to the responsibility of every country to decide on the measurement tasks and the related frequency ranges to be covered.

To define the essential measurement equipment characteristics for each operator position, the following points should be specified:

Frequency measurement (§ 4.2 of the Handbook¹)

- Frequency range.
- Required accuracy; is a central frequency standard available.
- Classes of emission (measurement method).

¹Note. This and the following paragraphs of the Handbook provide links to relevant ITU-R recommendations and reports.

Field strength, level and power flux-density measurement (§ 4.4 of the Handbook)

- Quantity and methods of measurements at fixed stations, at mobile stations.
- Required accuracy.
- Frequency range.

- Special measurements:
 - Coverage measurements (measurements along a route), measurement of antenna patterns (e.g. by helicopter).

Spectrum occupancy including channel occupancy measurement (§ 4.10 of the Handbook)

- HF emissions, VHF/UHF emissions.
- Technical specifications of channels: bandwidth, spacing, type of modulation.
- Duration of occupancy recording: continuous, time from ... to ..., special days, repartition of scans.
- Required scanning speed (software).
- Additional information to be recorded (e.g. call sign, automated identification/decoding).

Occupied bandwidth measurement (§ 4.5 of the Handbook)

- $\beta/2$ and/or x -dB method measurements using spectrum analyser or software.
- Others methods.

Modulation measurement (§ 4.6 of the Handbook)

- Modulation depth.
- Frequency deviation.
- Bit error rate (BER).
- Other quality parameters.
- Constellation diagram.

Direction finding and location measurement (§ 4.7 of the Handbook)

- System concept.
- Type of station: fixed, mobile, transportable, portable and required accuracy.
- Frequency range.
- Location (by triangulation or SSL) digital terrain mapping required.
- Response time.
- Needed space for DF antenna
- Display of bearings on digital maps.

Identification measurement (§ 4.8 of the Handbook)

- Classes of emission.
- Identification (e.g., decoding) of the various transmissions.
- “Fingerprinting”/“Individual transmitter envelope characteristics”.

Monitoring of spacecraft emissions (§ 5.1 of the Handbook) e.g.:

- Frequency, bandwidth, power flux-density measurements.
- Determination of orbital positions.
- Occupancy of frequency bands at orbital positions.

Multimedia broadcast (§ 5.2 of the Handbook) e.g.:

- Type terrestrial or satellite.

- Quality of received signal (needs special equipment)/decoding.

Cellular networks to be monitored (§ 5.3 of the Handbook):

- System parameters in order to identify the type of network.
- Field strength.
- Quality parameters (e.g. RxQual/CIR /BER) (more details on the issues of quality control of cellular networks are presented in a number of ITU-T Recommendations E series, for example, E.806).
- Additional information (e.g., handover for cellular radio).
- Number of channels.
- Maximum allowable distance between measurement points.
- Maximum distance between the measurement points of the same frequency/channel (valid for all allowed velocities).
- Is a special data evaluation tool needed and is it the intention to combine this system with the mobile monitoring (mapping) system?.

Microwave links including satellite links (§ 5.4 of the Handbook)

Receiving and measuring equipment in the 1 to 50 GHz range for which services? (equipment).

Editor's note №8. Section A3.5.2 – no change

Editor's note №9. Amend sections A3.5.3 and A3.5.4 as follows:

A3.5.3 Monitoring vehicles and devices

The VHF/UHF band mobile monitoring stations shall be designed and supplied housed in a vehicle, and shall be completely equipped with all necessary monitoring equipment, monitoring antennas, modem(s) communication antenna(s), GPS and GPS antenna, interconnecting cables, power supplies, cabinets, racks, mounting hardware, interface devices and terminal blocks to form a complete and working stand alone system, as well as a reliable component that is an integral part in the national spectrum monitoring system. The vehicle can be also equipped with portable measuring instruments for doing Spot Monitoring or exact interference source localization (§ 2.4.4 of the Handbook).

In the course of vehicle purchasing the following alternatives must be considered:

- Body of vehicle (van, jeep, passenger car).
- Engine type (petrol, diesel).
- Driven wheels (2 or 4).
- Size and weight.

A3.5.4 Software

The Management system and monitoring system shall contain a significant amount of software to automate data collection, processing, evaluation, and interference analysis tasks.

Using software to save spectrum monitoring results in relational databases and correlating this information with the central database of authorized users will save considerable research time while increases the accuracy.

The monitoring system application system and control software shall be developed in accordance with the ITU-R Recommendations, in particular ITU-R SM.1537, the ITU-R National Spectrum

Management ~~ITU-R Handbook [20052015]~~ and the relevant ITU-R Recommendations, mentioned in ~~of the this Handbook.~~ ~~on Spectrum Monitoring.~~

Pieces of monitoring application software:

- Digital mapping software.
- Direction finding software (integrated with the mapping software).
- Data base management software.
- Intelligent archive system software.
- Interface software between licensing database and monitoring measurement results.
- Measurement result evaluation software (data filters, post processes and graphically displays of data, automatic reference values and licence database compliance investigation).

The monitoring application program shall be of a user-friendly design, and shall be described in detail in the relevant manuals and guidelines.

Editor's note №10. Sections A3.5.5 and A3.5.6 – no change

Editor's note №11. Amend section A3.5.6.1 as follows:

A3.5.6.1 Site survey

The location of a fixed radio monitoring system has a very large effect on its efficiency and on the costs that are involved. Siting is governed by geographic, topographic and climatic conditions including local noise and sites must be selected very carefully because this must guarantee the required performance of the overall system.

Generally the user is responsible for site investigations. Documents, results of measurements, topographical maps, etc. must then be made available, including conclusions on ensuring the protection of future stations from interferences caused by powerful radio transmitters, as well as from the influence of environmental conditions (§ 2.6 of the Handbook and Recommendation ITU-R SM.575).

In developing the systems' operational concept the number of individual stations and their tasks will have been decided, and the selection of sites can be made according to ~~the ITU-R Recommendations~~ § 6.8 of the Handbook and Report ITU-R SM.2356.

In the HF range sites can be selected by evaluating computerized radio-propagation forecasts, but supplementary measurements should still be carried out on-site. Useful information is also provided by publications 1 and 2.

Editor's note №12. Sections A3.5.6.2 and A3.7 – no change

Editor's note №13. Amend section A3.8 as follows:

A3.8 Documentation

Equipment/system documentation is provided in the necessary language(s).

Detailed documentation must be available as part of the project, in doing so, the provisions of the following ITU-R Recommendations should be taken into account: SM.668, SM.1393, SM.1809 and SM.2117.

Editor's note №14. Sections A4 and A4.3 – no change

Editor's note №15. Amend section A4.4 as follows:

A4.4 Evaluation and comparison of proposals and award of contract

For the evaluation and comparison of proposals the purchasing administration needs to follow predefined process of evaluation such as:

- Procedures as defined by the International Telecommunications Union (ITU).
- Procedures as defined by the World Bank.
- Procedures in case the purchasing administration is not bound to the procedures from ITU or World Bank.

A Tender Evaluation committee appointed by the Purchaser authority will evaluate the bids from financial, legal and technical aspects. The evaluation methodology will be defined by the purchasing administration and should be described with all the details in the evaluation report of the Committee.

The proposals submitted by the bidders may be opened in the presence of Bidders' representatives at the stipulated time and place specified in the invitation to bid. Proposal may be rejected if not accompanied by Bid Bond.

During the evaluation the purchasing administration may ask clarifications to the bidders on their offers.

Useful information on evaluating and comparing proposals is provided in the ITU-D Guidelines.

Editor's note №16. From section A4.4.1 to the end of Annex – no change

Editor's note №17. Introduce new section "References" as follows:

REFERENCES

ITU-R texts

NOTE – In every case the latest edition of the ITU document should be used.

Handbooks

Handbook on National Spectrum Management, Geneva, 2015.

Handbook on Computer-aided Techniques for Spectrum Management (CAT), Geneva, 2015.

Recommendations

Recommendation ITU-R SM.575 – *Protection of fixed monitoring stations against interference from nearby or strong transmitters*

Recommendation ITU-R SM.668 – *Electronic exchange of information for spectrum management purposes*

Recommendation ITU-R SM.1050 – *Tasks of a monitoring service*

Recommendation ITU-R SM.1054 – *Monitoring of radio emissions from spacecraft at monitoring stations*

Recommendation ITU-R SM.1139 – *International monitoring system*

Recommendation ITU-R SM.1392 – *Essential requirements for a spectrum monitoring system for developing countries*

Recommendation ITU-R SM.1393 – *Common formats for the exchange of information between monitoring stations*

Recommendation ITU-R SM.1394 – *Common format for Memorandum of Understanding between the agreeing countries regarding cooperation in spectrum monitoring matters*

Recommendation ITU-R SM.1413 – *Radiocommunication Data Dictionary for notification and coordination purposes*

Recommendation ITU-R SM.1447 – *Monitoring of the radio coverage of land mobile networks to verify compliance with a given licence*

Recommendation ITU-R SM.1537 – *Automation and integration of spectrum monitoring systems with automated spectrum management (E-only)*

Recommendation ITU-R SM.1681 – *Measuring of low-level emissions from space stations at monitoring earth stations using noise reduction techniques*

Recommendation ITU-R SM.1723 – *Mobile spectrum monitoring unit*

Recommendation ITU-R SM.1754 – *Measurement techniques of ultra-wideband transmission*

Recommendation ITU-R SM.1792 – *Measuring sideband emissions of T-DAB and DVB-T transmitters for monitoring purposes*

Recommendation ITU-R SM.1809 – *Standard data exchange format for frequency band registrations and measurements at monitoring stations*

Recommendation ITU-R SM.1875 – *DVB-T/T2 coverage measurements and verification of planning criteria*

Recommendation ITU-R SM.2039 – *Spectrum monitoring evolution*

Recommendation ITU-R SM.2117 – *Data format definition for exchanging stored I/Q data for the purpose of spectrum monitoring*

Reports

Report ITU-R SM.2130 – *Inspection of radio stations*

Report ITU-R SM.2156 – *The role of spectrum monitoring in support of inspections*

Report ITU-R SM.2182 – *Measurement facilities available for the measurement of emissions from both GSO and non-GSO space stations*

Report ITU-R SM.2304 – *Application of technical identification and analysis of specific digital signals*

Report ITU-R SM.2356 – *Procedures for planning and optimization of spectrum-monitoring networks in the VHF/UHF frequency range*

Report ITU-R SM.2424 – *Measurement techniques and new technologies for satellite monitoring*

Report ITU-R SM.2452 – *Electromagnetic field measurements to assess human exposure*

Report ITU-R SM.2453 – *Cooperation in the field of space radio monitoring*

Report ITU-R SM.2486 – *Use of commercial drones for ITU-R spectrum monitoring tasks*

Report ITU-R SM.2504 – *Methods for the estimation of coverage for terrestrial radio services based on population*

ITU-D text

Guidelines for the preparation of a tender to set up or update a spectrum monitoring network. Geneva, 2016. https://www.itu.int/en/ITU-D/Spectrum-Broadcasting/Documents/Publications/Guidelines_SpectrumMonitoring_Final_E.pdf

ITU-T texts

Recommendation ITU-T V.24. – List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE). <https://www.itu.int/rec/T-REC-V.24>

Recommendation ITU-T E.806. – Measurement campaigns, monitoring systems and sampling methodologies to monitor the quality of service in mobile networks. <https://www.itu.int/rec/T-REC-E.806>

Publications

- [1] Pavlyuk (Pavliouk) A.P., Plossky A.Yu. *Planning and optimization of spectrum monitoring networks of developing countries in the high frequency range*. Znanstvena misel journal (Slovenia), № 28, Vol. 1, 2019. <https://www.znanstvena-journal.com/archiv/>. The text is available at: www.pavlyuk.com, section «Publications»).
- [2] Chaouachi K., El Helali N., Pavlyuk (Pavliouk) A., Plossky A., Souai Ep Lakhal S. *Implementation of spectrum monitoring systems of the high frequency range in developing countries having relatively small territories*. Norwegian Journal of development of the International Science, № 53/2021, Vol. 1 (published in French at: <https://www.nor-journal.com/archive/>, translation into English is available at: www.pavlyuk.com, section «Publications»).