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# Proposal of methodology for risk assessment in use of mobile phones

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**Abstract—**Seen from the health, ethical and social aspects of the use of radio equipment imply the existence of a risk to the users of this type of equipment. Although the safety is of great importance for usage of radio equipment, there is still no general standard which defines principles for the design of this type of equipment with emphasis on assessment and risk reduction. The working version of risk assessment procedure for products which do not fulfill the essential requirements of the Directive for radio and telecommunication terminal equipment (RTTE Directive) has not yet been completed, although the working group ADCO R&TTE has been working intensively on this project in previous years. Based on the new standard for risk assessment in the field of machinery, EN ISO 12100, this paper shows one possible solution for risk assessment methodology in the use of mobile phones. Mobile phone is taken as a typical representative of radio equipment. The aim of this research is to define all possible risks in the use of mobile phones and to make appropriate risk assessment methodology.

**Keywords—**radio equipment; risk assessment; EN ISO 12100; methodology; mobile phone

## I. INTRODUCTION

European Union has developed instruments for removing obstacles to free movement of goods, which ensued from differences in technical regulations of the member states. Among these instruments, the New Approach to Technical Harmonization and Standardization and Global Approach to certification and Conformity Assessment, take the prominent position [1]. The New Approach Directives were brought with the aim of providing free flow of products which are in accordance with the level of protection determined by the Directives. The Directives were developed as protection from possible risks connected with public interests.

Progress in the product conformity assessment procedure has been made by integrating the requirements for technical products safety into the process of designing, where risk levels are preventively analyzed and quantified, for the purpose of determining the scope of necessary safety systems [2]. The New Approach Directives and some harmonized standards state explicitly the risk assessment procedure. If the risk assessment is not stated in the directive, it may be required by the standard related to the directive.

Directive 1999/5/EC of the European Parliament and Council dated March 9$^{th}$, 1999 on radio and telecommunication terminal equipment covers all products which use frequency spectrum [3]. This directive also refers to terminal equipment connected to public telecommunication networks. New Directive 2014/53/EU which will replace Directive 1999/5/EC only refers to radio equipment. For radio equipment there still is no general standard which would define the principles for designing this type of equipment, with the highlight on risk assessment and risk reduction.

On the basis of a new standard for risk assessment in the field of machinery, the EN ISO 12100, this paper provides a proposal of the methodology for risk assessment in use of the mobile phone. The paper defines almost fifty different situations for which there is a certain probability of happening during mobile phone usage. This paper gives proposals of methodology for risk assessment in use of mobile phones all with the objective of protecting the customer health and safety.

 

## II. INFLUENCE OF MOBILE PHONE ON USER HAELTH AND SAFETY

Mobile phones create electromagnetic field which, under certain conditions, can be detrimental to health. Numerous changes in the reproductive, brain, osteo-cartilage and other tissues have been observed after their exposure to electromagnetic radiation.

The quantity of absorbed energy and distribution of energy in the subject exposed to the action of electromagnetic field is the function of electric field strength and magnetic induction in the subject itself. The resulting distribution of energy can be described by the term specific absorption – SAR (Specific Absorption Rate), defined as the speed of accretion of the energy absorbed according to the unit of mass [4]. SAR is frequentially dependent quantity and has the maximum value at the resonant frequency which, for humans, is the value of 100MHz [4]. The limit value for SAR is 2W/kg.

In essence, two types of electromagnetic radiation are distinguished – thermal and non-thermal. Thermal effects have been rather well studied and they cover philosophical effects, effects of change of behavior, etc. On the other hand, there are contradictory opinions regarding the existence of non-thermal effects, so that further research work is expected in this area to prove or deny validation of these effects.

World Health Organization (WHO) has announced that mobile phone radiation is one of potential causes of cancer. Mobile phone has been class "2B" according to the IARC (International Agency for Research on Cancer) classification which, among others, includes also: lead, DDT insecticide, exhaust gasses, petrol and diesel fuels, etc.

Influence of mobile phone on user safety can analyzed thought ethical aspect of mobile phone use. The progress of technology has not changed the basic ethical rules, but new technologies have caused new approach to non ethical behavior. The issues of privacy infringement, intellectual property piracy and spreading of false information have gained larger dimensions in the Internet. The ease of obtaining and sharing of personal information on the Internet presents a great problem and can bring about jeopardizing the user's safety.

There are also a lot of social problems relating to usage of mobile phones. For example, exploitation of children by way of information-communication technologies represents a social problem and is called virtual or electronic violence. Electronic violence is generally characterized by sending or publishing insulting or violent contents by using Internet available by computers, mobile phones or other electronic means.

## III. RISK REDUCTION METHODOLOGY IN THE NEW APPROACH DIRECTIVES

EU business practice shows that risk analysis and risk reduction estimation have been widely accepted in the process of products development. Manufacturers or their authorized representatives in EU are obligated to perform risk analysis and estimation for their products with respect to fulfilling basic requirements defined in the directives, as well as to offer, on the basic of such analysis, product design solutions that fully meet such requirements.

Manufacturer's basic task is to make the product safe. The best way to realize product safety is to create and realize the inherently safe structure which is accomplished by the design process, adequate manufacturing process, including all the tests and controls and by adequate work process in which the products are used.

Risk assessment has to be conducted in the phase of product development and designing, so as to enable most efficient realization of all the necessary improvements ensuing from the assessment.

The risk assessment methodology in the New Approach Directives can be explained on the example of risk reduction methodology given in general form in the standard EN ISO 12100:2010, and depicted in Fig.1 [5].

 

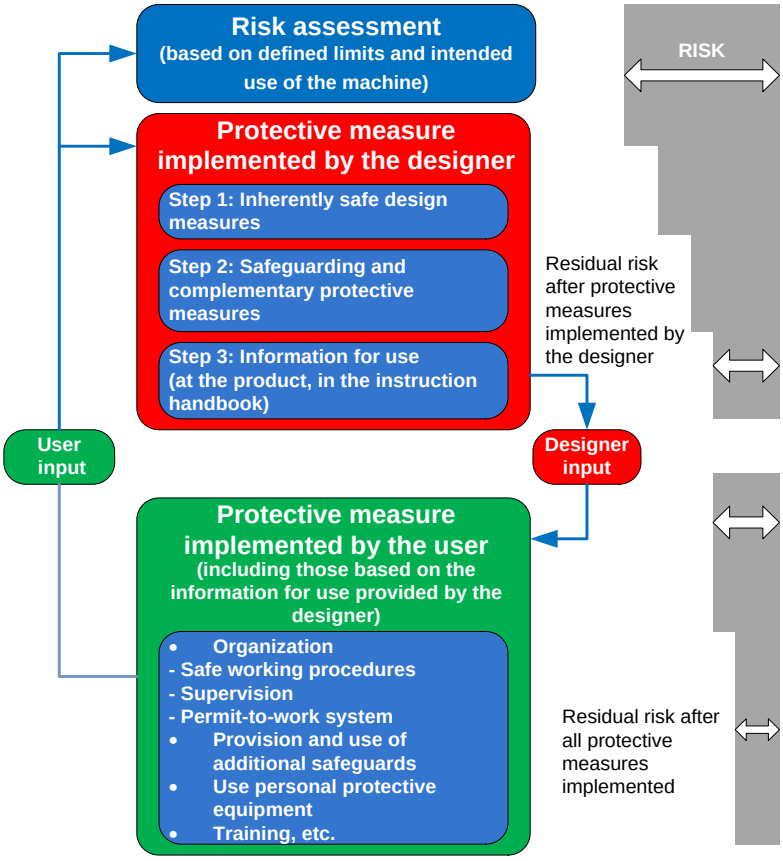


***Figure 1. Risk reduction methodology in the New Approach Directives***

The risk reduction methodology is based on several steps. The manufacturer or his authorized representative determine the risk level for identified hazards, by using the harmonized standards through the procedure of risk assessment, taking into consideration the limitation in which the machine performs its function. In case that it is determined after evaluation activity that identified risk exceeds the acceptable level, measures are called for its reduction.

In accordance with the risk reduction methodology shown in Fig. 1, the manufacturer will first tray to reduce the risk by modifying the existing design solutions. Manufacturer can try to achieve risk reduction through the so-called "inherently safe structure". If the renewed risk assessment shows that risk level is still high, the manufacturer takes sufficient measures such as installing adequate protection aimed at additional risk reduction. It is supposed that despite all previously taken measures, residual risk still subsist, so that manufacturer or his authorized representative is obligated to inform the future user of all these risks, by way of designation on the machine and by instruction for use.

Additional risk reduction is expected from the user as well. The user is obligated to additionally reduce the risk on the basis of information received from the manufacturer or his authorized representative. This mostly refers to: establishing of work organization, use of additional protective measures, use of personal protective means, adequate training of operators, etc.

If all the risks are covered by harmonized standards, then there is no need for additional assessment and risk reduction.

## IV. RADIO EQUIPMENT RISK ASSESSMENT

During the process of radio equipment designing risk levels are analyzed and quantified for the purpose of determining the scope of necessary safety systems. The radio equipment manufacturers are obligated to perform risk analysis and estimation for their products with respect to fulfillment of basic

requirements in the RTTE Directive and to offer, on the basis of the estimation, product design solutions which fully meet those requirements.

Conformity to the basic RTTE Directive requirements is achieved by implementing harmonized standards. The list of current valid harmonized standards is periodically published in the Official Journal of the EU. The risk assessment procedure is not stated explicitly in the RTTE Directive, but risk assessment is required by the standards which are linked with the directive. There is no single standard for radio equipment dealing with general principles for designing of this equipment, with the emphasis on risk assessment and risk reduction, as is the case with machines and the EN ISO 12100:2010 standard.

In the case of radio equipment, there is a set of harmonized standards dealing with hazards that might happen with this type of equipment. If all hazards are covered by harmonized standards, then it is not necessary to perform risk analysis and assessment for that product. If that is not the case, or if hazards are covered only by part of harmonized standard or if harmonized standard does not exist, adequate generic standard must be used for risk assessment, such ES ISO 12100:2010, while risk assessment is implemented in compliance with the procedure defined in that standard.

### 4.1. Draft version of risk assessment procedure for products which do not fulfill the essential requirements of RTTE Directive

Due to obligation of the EU member states, given in Article 20, paragraphs 1 and 2 of the Regulation 765/2008/EC, the market supervision authorities within the ADCO R&TTE and ADCO EMC organizations have been working on developing adequate risk assessment procedure for the products to which the RTTE and EMC directives relate to.

In Appendix 5 to the document, under the headline *Guidelines for the management of the Community Rapid Information System RAPEX (Commission Decision 2010/15/EU),* a risk assessment method has been set up which should be used by all the EU countries in estimating risk level of user products and in taking the decision whether a product is safe for health of people and whether a RAPEX notification is necessary. The task group within the ADCO R&TTE is currently considering in what way it is possible to identify nonconforming products which represent a serious risk and in case of which the RAPEX procedure should be initiated.

RAPEX guidelines currently focus on injury risk for persons. The New Approach Directives have much broader aspect of the subjects which must not be affected by risk. SOGS-MSG (*Senior Officials Group on Standardization and Conformity Assessment Policy Market Surveillance Group*) has asked the EU Commission to develop a risk assessment procedure applicable to all the 27 New Approach Directives. RATF (*Risk Assessment Task Force*) was formed to analyze the existing procedures and to identify adequate system of general risk estimation. Fig. 2 shows a block diagram of the risk estimation working version procedure for products which do not meet basic RTTE Directive requirements [6]. The depicted procedure is currently being discussed by the RATF. Explanation of each step of the procedures is given in [1].

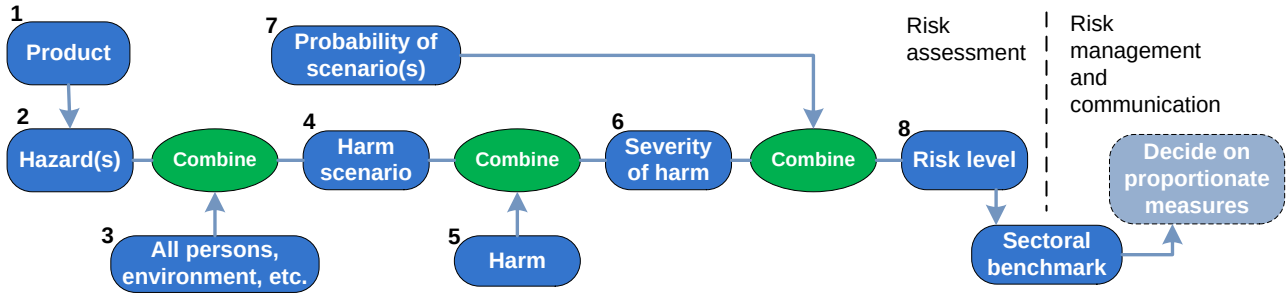


***Figure 2. Draft version of risk assessment for products which do not fulfill the essential requirements of the RTTE Directive [6]***

The basic aim of the risk estimation procedure is to determine risk level in product which is not in conformity with the essential requirements of the RTTE Directive. If a member state establishes that a product within the RTTE Directive is not in accordance with basic directive's requirements due to irregular implementation of harmonized standards or due to shortcomings in harmonized standards, then the member country immediately informs the Commission in accordance with the procedure, or informs the Commission and other member states in accordance with Article R31 (5) of the Decision 768/2008/EC.

### 4.2. Improved procedure for risk assessment and risk reduction for radio equipment

On the basis of risk assessment procedure draft version, as depicted in Fig. 2 and on the basis of the strategy for machinery risk assessment and reduction defined in standard ISO 12100:2010, Fig. 3 shows a proposal for complete risk assessment and reduction procedure for radio and telecommunication equipment.

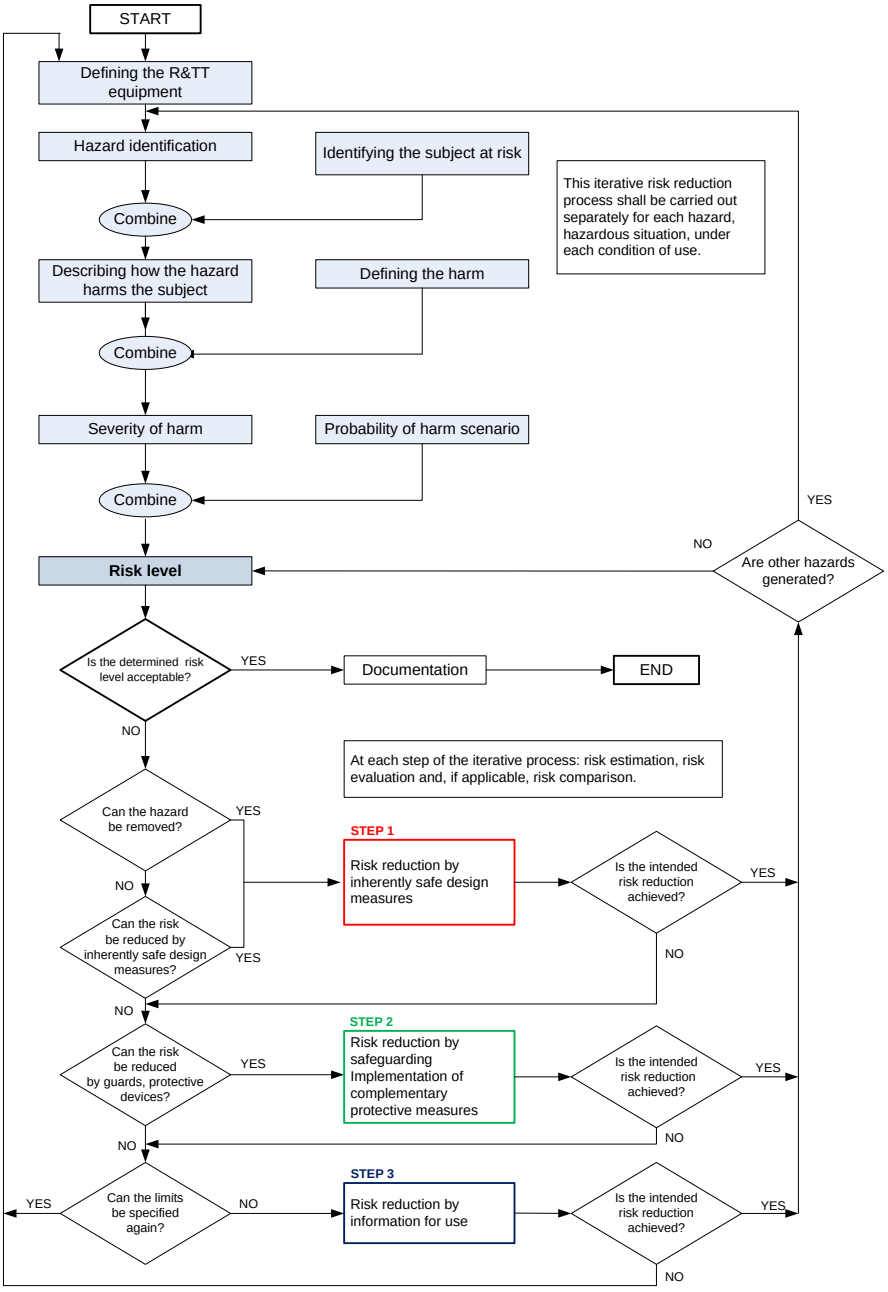


***Figure 3. Proposed procedure for risk assessment and reduction for products which do not meet basic RTTE Directive requirements [1]***

The strategy for risk assessment and reduction for R&TTE equipment, which is detailed explained in [1], comprises the following phases:

- *Determining R&TTE equipment limits, taking into account intended usage as well as predictable misuse of the equipment;*
- *Identifying hazard and associated hazardous situations;*
- *Risk assessment for each identified hazard and hazardous situation;*
- *Risk evaluation and taking decisions regarding risk reduction need;*
- *Eliminating hazards and reduction of the risk associated with that hazard, by protective measures.*

After risk assessment there is risk reduction method, when it is necessary. It is sometimes necessary to reiterate this process with the aim of hazard elimination, as long as this attainable and in order to reduce risks by implementing protective measures.

## V. METHODOLOGY FOR RISK ASSESSMENT IN THE USE OF MOBILE PHONES

On the basis of the risk assessment and reduction methodology given in standard EN ISO 12100, as well as on the basis of the proposal for the R&TT equipment and general procedure for risk assessment and reduction given in [1], this chapter provides the methodology proposal for risk assessment and reduction in the mobile phone usage.

The risk assessment methodology in mobile phone usage covers consideration of all the risk factors involved including also the unpredicted parameters. The methodology has to answer the questions, such as: what risks there are in using mobile phones; what incidents can be expected; what measures can be taken; what the possible consequences there are; what probability there is of hazardous events occurrence; what the costs there are – alternative technologies, etc. The risk assessment methodology is explained through next five subclasses.

### 5.1. Functional Analysis

The beginning of functional analysis requires gathering of a series of information, such as information related to mobile phone description (technical specification, description of possible users, instructions for use); information related to applicable regulations, relevant standards, recommendations and other documents with the data on safety relating to mobile phones and information related to the experience in use (information on accidents, incidents or malfunctions, data on health hazards, users' experience with similar type of equipment).

The precise defining of the equipment entails determining limits of use (frequency band, maximum radiated power, type of antenna, emission class, types of connections, type of power supply, etc.)and also different modes of the equipment operation as well as the procedure for interventions in case of equipment malfunction. Additional, useful information for functional analysis are: type of equipment use (industrial use, home use, personal use, etc.), type of the equipment user, spatial and climate limitations in using the equipment and equipment time limitations (life limits of the equipment or some of its components, recommended servicing intervals, etc.).

### 5.2. Identification of Hazards

Depending on the type of radio equipment, there are several types of hazards. The identified hazards can be of mechanical, electrical, thermal nature. Also, during use of some radio equipment, hazards can occur from too loud noise, vibrations or electromagnetic radiation. In the use of radio equipment, there is often identified hazard of occurrence of detrimental interferences which can significantly jeopardize operation of radio-navigation and radio-communication services. There are numerous hazards that can be identified in the course of irregular radio equipment use (e.g. disallowed stay in the vicinity of massive antenna facilities, mobile phone use during driving, etc.). Also, it is necessary to mention the occurrence of electronic violence, as well as increasingly frequent hazard occurring in using information-communication technologies made available by the radio equipment.

 

In order to identify the hazards, it is necessary to identify the manner of the equipment operation and the tasks to be performed by persons in interactions with the equipment. It is also necessary to consider both normal and irregular equipment operations, as well as reasonably foreseeable misuse of the equipment. Table 1 provides the list of possible hazards in the mobile phone use.

***Table 1. Identification of potential hazards in mobile phone use***

| No | Hazard Type | Hazard |
|---|---|---|
| 1 | Mechanical | Mechanical damage of the device and its additional equipment, small parts of the device and additional equipment |
| 2 | Electrical | Damaged supply cables, damaged plugs, loose electrical receptacles |
| 3 | Thermal | Exposing the device to extreme temperatures |
| 4 | Noise | Exposing ears to very high tones |
| 5 | Radiation | Electromagnetic radiation |
| 6 | Composition of the materials used | Incorrect storing of the device and its additional equipment |
| 7 | Hazards caused by the environment in which mobile phone is used | Mobile phone use in open space during thunder storm, exposing the device to high pressure, use of the device in area with high dust concentration, use on airplane, device use during driving, submitting the device to thick smoke and fumes |
| 8 | Hazards caused by using ICT | Electronic violence |
| 9 | Environmental | Increasing electronic waste landfill permanently pollutes the land as well as surface and ground water. |

### 5.3. Identification of Subjects Exposed to Hazards

Table 2 defines possible equipment users, i.e. mobile phone users.

***Table 2. Identification of subjects exposed to hazards***

| No | User Type | User Category |
|---|---|---|
| 1 | Very vulnerable users | Children |
| 2 | Vulnerable users | Pregnant women, patients with pacemaker |
| 3 | Other users | Users not belonging to user type 1 and 2 |

### 5.4. Description of Hazard Impact on the Subject + Injury/Damage

On the basis of safety information provided by the manufacturer, a list has been composed in Table 3 of the scenarios describing how hazards influence the subject, stating also injuries/damage occurring on that occasion. Throughout our research almost fifty different situations for which is a certain probability of occurrence during mobile phone usage are defined. The basis for composing Table 3 has been a few instructions for use of the mobile phones produced by different manufacturer.

### 5.5. Determining Hazard Level, Injury Degree

Risk severity is defined through injury/damage to user's health or through device damage, and is given in Table 4. Level 4 risks are the risks the severity of which is highest and due to which major irreversible consequences occur. Level 3 risks are the risks of high severity due to which significant negative consequences occur that can be eliminated in longer time periods by way of special interventions entailing significant effort, and which can be irreversible in case when certain interventions are not applied. Level 2 risks, i.e. the risks of small severity, cause negative consequences that can be eliminated in a certain time period with the use of special instructions/consultations. The least severity risks are those of level 1 which cause negative consequences which usually can fully be removed in short time period without special instructions.

### 5.6. Determining probability of damage/injury occurrence

Frequency of risk occurrence is shown in Table 5. It is estimated for each severity level and expressed qualitatively, as: frequent, probable, occasional, rare and improbable.

 

***Table 3. How hazard affects the subject + injury/damage***

| No | Injury Scenario | Injury/Damage |
|---|---|---|
| 1 | The user uses damaged supply cables, damaged plugs or loose electric receptacles. | Electric shock, fire |
| 2 | The user touches supply cable with wet hands or switches off the charger by pulling the cable. | Electric shock |
| 3 | The user bends and thus damages the supply cable. | Electric shock, fire |
| 4 | The user uses the device while it is still being charged or touches the device with wet hands. | Electric shock |
| 5 | The user short-circuits the charger or the device. | Electric shock, fire, battery failure or explosion |
| 6 | The user uses the device outdoors during thunder storm. | Electric shock, device malfunction |
| 7 | The user uses the battery, charger, additional equipment which is not approved by the manufacturer. | Shortening of device operating life, fire, battery explosion |
| 8 | The user sets the battery or device on/into the heating device such as microwave oven, kitchen range or radiator. | Device overheating, explosion |
| 9 | The user exposes the device to high pressure. | Internal short circuit, overheating |
| 10 | The user exposes the device to extreme temperatures. | Decreasing charging capacity and life of the device and battery |
| 11 | The user uses or stores the device in the area of high concentration of dust or particles in the air. | Fire, electric shock |
| 12 | The user bites or sucks the device or battery. | Device damage, explosion or fire, danger of suffocating by small parts |
| 13 | The user puts the device or the delivered additional kit into his/her eyes, ears or mouth. | Suffocation, serious injuries of eye sight and hearing |
| 14 | The user uses the device in the vicinity of other electronic devices.<br>Note: Using of LTE connection for transfer of data can cause interferences with other devices, such as audio equipment and phones. | Possible hindrance of other electronic devices operation, interference |
| 15 | The user used the device in the range less than 15 cm from the pacemaker or in vicinity of the hearing aid. | Obstruction of pacemaker operation, Obstructed hearing aid operation |
| 16 | The user uses the device on the plane. | Obstruction of plain electronic navigation instruments, interference |
| 17 | The user uses the device during car driving. | Interference with car electronic devices, car accident, death |
| 18 | The user exposes the device to thick smoke or fumes. | Damaged device outer surface, device failure |
| 19 | The user uses the device in the vicinity of massive loudspeaker systems or radio towers. | Device malfunction |
| 20 | The user uses the device in potentially explosive environments.<br>Note 1: In potentially explosive environments, battery should not be removed but the device should only be switched off.<br>Note 2: The device should not be used in fuel filling locations, or in the vicinity of fuels or chemicals.<br>Note 3: The device or its parts and connections should not be carried together with flammable liquids, gases or explosive materials.<br>Note 4: The device should be designed so as to satisfy the basic requirements of the Directive on equipment and protective systems intended for use in potentially explosive atmospheres (ATEX Directive 94/9/EC) | Explosion, fire |
| 21 | The user dampens the device or switches on the device when it is wet. | Device failure |
| 22 | The user leaves the device on surfaces that are not flat and from which the device can fall. | Device damage, failure |
| 23 | The user leaves the device on very hot or very cold locations.<br>Note 1: It is recommended that the device should be used at temperatures from 5°C to 35°C<br>Note 2: It is recommended that the battery is stored at temperatures from 0°C to 45°C | Screen malfunction, device damage, battery explosion |
| 24 | The user holds the device on metal objects such as coins, keys and necklaces.<br>Note: In case the battery poles come into contact with metal objects, there is the possibility of fire occurrence. | Scratching of the device, failure |
| 25 | The user keeps the device in the vicinity of a magnetic field.<br>Note 1: Magnetic fields can damage the card with magnetic stripes, including credit cards, phone cards, bank booklets and plane passes.<br>Note 2: The device should be designed so as to satisfy the basic requirements of the EMC Directive 2004/108/EC | Device failure, battery discharge |
| 26 | The user uses the device immediately after the device has been overheated. | Burns on the skin, red spots and pigmentation |
| 27 | The user uses the device with the rear cover removed from the device. | Falling out of the battery, damage and failure |

 

| No | Injury Scenario | Injury/Damage |
|---|---|---|
| 28 | The user uses flash light or camera light near the eyes of persons or pats. | Temporary loss of eye sight |
| 29 | The user is exposed, in longer time periods, to the flickering light from the device screen. | Fainting, eye muscle cramps, disorientation |
| 30 | The user repeats continually the activities such as pressing of keys, drawing signs on the screen which is sensitive to touch or playing games. | Discomfort in hands, neck, shoulders |
| 31 | In using ear buds, the user exposes his/her ears to loud sounds.<br>Note: In dry environments, static electricity can occur in ear phones. It is necessary for users to avoid ear phones in dry environments or to touch a metal object in order to discharge static electricity prior to connecting earphones to the device. | Hearing damage, distracting attention from the current user's activity, accident |
| 32 | The user wears the device in rear pocket or around the waist line. | Injury, damage of the device (if the user falls down) |
| 33 | The user paints or sticks stickers to the device.<br>Note 1: Paint and stickers can obstruct movable parts and disable correct device operation.<br>Note 2: If the user is allergic to paints or metal device parts, skin irritation marks can appear. | Malfunctioning of the device, itching, eczema or swelling of the skin |
| 34 | The user uses the device with cracked or broken screen. | Injuries to hands and face |
| 35 | The user drops or hits the device. | Device damage, failure |
| 36 | The user overcharges the device battery. | Shortening of battery life |
| 37 | The user covers the antenna area by hands or other objects. | Problems in establishing connection, discharging battery, increased level of EM radiation |
| 38 | The user disassembles or punches the device battery. | Explosion, fire |
| 39 | The user removes the battery when the device is switched on. | Device malfunction |
| 40 | The user uses chemicals or detergent to clean the device. | Corrosion of outer device surface, electric shock, fire |
| 41 | The user removes the SIM card or memory card from the device while transferring or accessing information. | Data loss, card damage, device damage |
| 42 | The user does not have spare copy of important data from the device. | Loss of data |
| 43 | The user disposes of/throws the device which has not been reset. | Personal data abuse |
| 44 | The user does not lock the device by a password or PIN code. | Personal data abuse |
| 45 | The user takes over unknown applications, visits non-reliable web locations, does not delete doubtful messages or e-messages from unknown senders, does not change his/her password regularly, does not deactivate wireless functions when not in use, does not start antivirus program prior to starting taken over applications and files, does not modify operational system of the device. | Damage or loss of data, all forms of electronic violence |
| 46 | The user carries or uses the device at the distance less than 1,5cm away from the body.<br>Note 1: It is necessary for the user to check if the device fulfills the requirements regarding national SAR (*Specific Absorption Rate)* limit values of 2W/kg | Increased level of electromagnetic radiation |
| 47 | The user leaves the device and its additional electronic equipment or battery together with other home waste materials.<br>Note: In order to prevent jeopardizing the environment and health of people, it is necessary that the device, battery and additional electronic equipment be separated from other scrap and to be recycled for the purpose of promoting the renewed use of material resources. | Jeopardizing environment and people's health |

***Table 4. Defining level of damage/harm, injury degree***

| Level | Risk severity | Injury/damage/harm |
|---|---|---|
| 4 | Catastrophic | Death or complete obstruction of radio-communication system. |
| 3 | High | Severe user's injury or major harm of radio-communication system, major device harm. |
| 2 | Small | Small user injury, small damage of radio-communication system, small device damage |
| 1 | Neglectable | Very small user injury, very small damage of radio-communication system, very small device damage |

## 5.7. Determining of risk level

The connection between risk severity level and the frequency of its occurrence enables risk level determining. The levels are grouped into 4 categories (A, B, C, D) where A risk level is the highest, while D is the lowest risk level. Risk levels enable ranking of risks, which contributes to more

efficient planning of protection measures, i.e. to defining priorities. Risk level as defined in [7] is shown in Table 6.

***Table 5. Defining probability of damage, injury occurrence***

| Risk frequency | Description | Note |
|---|---|---|
| Frequent | It is probable that the risk will occur frequently | Felt frequently |
| Probable | It will occur several times during duration life of an activity | Will occur often |
| Occasional | It will probably occur at some time during life of an item. | Will occur several times |
| Negligible, rare | It is not probable but is possible that it will occur during life of an item. | Not probable but it is reasonable to expect the occurrence |
| Not probable | There is little probability to suppose that the occurrence might not be experienced. | Not probable to happen but possible |

***Table 6. Defining risk level***

| Occurrence Frequency | Risk Severity | | | |
|---|---|---|---|---|
| | *Catastrophic* | *Severe* | *Small* | *Negligible* |
| Frequent | A | A | A | C |
| Probable | A | A | B | C |
| Occasional | A | A | B | D |
| Rare | A | B | C | D |
| Improbable | B | C | C | D |

### 5.8. Risk evaluation

After completing risk assessment it is necessary to perform risk evaluation so as to determine if risk reduction is needed. With respect to the level, risks can be defined as unacceptable and as acceptable. When it is determined that a risk is unacceptable, risk reduction is necessary by applying adequate protective measures. When a risk is acceptable, no further risk analysis is needed. Level A risk always requires actions for risk reduction, while level D risk can be considered as acceptable risk and further risk analysis is not necessary. Levels B and C risks require some form of risk reduction, where organizational measures aimed at risk reduction are quite sufficient for level C risks.

### 5.9. Analysis of risk reduction possibilities

Risk reduction can be achieved by reducing the hazards or by reducing damage severity from the hazard being considered and/or the probability of that damage occurrence. Protective measures intended for reaching this objective should be applied according to the so called three-step method given in standard EN ISO 12100 and according to proposed procedure shown in Figure 3.

## VI. CONCLUSION

Risk assessment and risk management in technical systems both imply very important economic and general social problems. Successful solving of the issues of risk management is possible if the phenomena that are managed, as well as the management methods are known. )

By referring to relevant and realistic facts, measurements and research works, this paper indicates the consequences that can occur in using radio equipment, primarily in case of mobile phone. Further development of the shown procedure contributes to improving safety of radio equipment from the point of view of protecting health and safety of people and other public interests. Use of the standard EN ISO 12100 in risk assessment from area of machinery represents one of possible solution in accomplishing the concept of radio equipment safety.

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