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Przyjęty/Accepted/Принята: 17.01.2014;

Zrecenzowany/Reviewed/Рецензирована: 05.11.2015;

Opublikowany/Published/Опубликована: 31.12.2015;

CBRN Analysis and SI Promień – Comparison of the Functionality of the Software for the Assessment of Contamination²

CBRN Analysis i SI Promień – porównanie funkcjonalności oprogramowania do oceny sytuacji skażeń

CBRN Analysis и SI Promień – сравнение функциональности программного обеспечения для оценки ситуации загрязнения

ABSTRACT

Aim: The aim of this article is the assessment of functionality of both systems in the light of interoperability of National Warning and Reporting System (KSWSiA) components. The authors intended to confirm that SI Promień system is comparable to another high-end IT solution for predicting and assessing contamination which is CBRN Analysis.

Introduction: Nowadays, in the National Warning and Reporting System (KSWSiA) there are simultaneously utilized two independent CBRN information management systems: SI Promień and CBRN Analysis; however the second one serves for military purposes only. KSWSiA is a specific super-system aimed at providing a synergy between all systems responsible for CBRN contamination detection, warning and reporting. The military part, which is the so-called Contamination Detection System, is the protoplast of the whole system providing procedures on measurements and information exchange. Evolution of the IT systems during the last decade helped to develop modern systems supporting or even replacing humans in the area of CBRN information management and assessment of hazards. An example of such a system is CBRN Analysis – currently a world-leading solution which became an inspiration for national programmers to create modern and effective approach to CBRN hazard prediction and information management. Today, we have almost 10 years of experience in application and improvement of domestic software but it is still under development which is a result of new requirements and changes in NATO standardization documents.

Methods: Conducted research is based on software diagnosis and the analysis of end-user experience. A fundamental challenge was the selection of software usability determinants and the comparison of both systems. During research authors applied the following methods: observation (conducted during courses and exercises in CBRN Defence Training Centre), comparison, analogy, abstraction, analysis and synthesis.

Conclusions: Results revealed that both systems apply a unique approach to CBRN information management. Besides slight superiority of CBRN Analysis deriving from a long-term presence on the market and engaged resources to sustain such dominance, authors denoted SI Promień as an optimal future solution, which provides interoperability for purposes of KSWSiA and unification of interim subsystems. The key issue conditioning the opportunity to develop the software is its compatibility with the existing command and control systems, and certification of SI Promień according to international requirements in order to confirm its value for the development of Polish defense capabilities. Nevertheless, SI Promień confirmed that it is the forefront of similar systems with a great potential for further development and to satisfy current and future needs of KSWSiA.

Keywords: CBRN information management, contamination prediction and assessment, CBRN risk management, automated contamination warning and reporting systems

Type of article: best practice in action

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ABSTRAKT

Cel: Celem artykułu jest ocena funkcjonalności obu systemów w świetle zapewnienia interoperacyjności elementów Krajowego Systemu Wykrywania Skażeń i Alarmowania (KSWSiA). Zamiarem autorów było potwierdzenie funkcjonalności SI Promień w porównaniu z innym, wiodącym rozwiązaniem IT w zakresie prognozowania i oceny sytuacji skażeń, tj. CBRN Analysis.

Wprowadzenie: W KSWSiA wykorzystywane są obecnie dwa niezależne systemy zarządzania informacjami CBRN, tj. systemy informatyczne o nazwach: PROMIEN i CBRN Analysis, przy czym drugi stosowany jest wyłącznie w Siłach Zbrojnych RP. KSWSiA jest specyficznym „super” systemem, który ma zapewnić efekt synergii między wszystkimi elementami odpowiedzialnymi za wykrywanie zagrożeń CBRN, a także ostrzeganie i alarmowanie. Część wojskowa, zwana Systemem Wykrywania Skażeń, jest protoplastą obecnego KSWSiA i zapewnia jego interoperacyjność zarówno w wymiarze krajowym, jak i sojusznicy. Ewolucja systemów IT w ciągu ostatniej dekady spowodowała również rozwój nowoczesnych systemów wspomagających, czy nawet zastępujących ludzi w obszarze zarządzania informacjami CBRN oraz oceny tych zagrożeń. Przykładem takiego systemu jest CBRN Analysis – aktualnie wiodące, światowej klasy rozwiązanie. Stało się ono inspiracją dla polskich programistów, których celem było stworzenie nowoczesnego i efektywnego narzędzia do prognozowania zagrożeń CBRN i zarządzania informacjami w tym obszarze. Dziś posiadamy prawie 10 lat doświadczeń w zakresie użytkowania i udoskonalania własnego oprogramowania, jednak nadal trwają jego prace rozwojowe, co wynika z identyfikacji nowych potrzeb oraz zmian w dokumentach standaryzacyjnych NATO.

Metody badawcze: Przeprowadzone badania oparto na diagnozie oprogramowania oraz analizie doświadczeń użytkowników końcowych. Zasadniczym wyzwaniem było określenie, jakie determinanty decydują o użyteczności obu narzędzi w rozpatrywanym kontekście, a następnie porównanie względem nich stosowanych rozwiązań. W badaniach zastosowano metody: obserwacji uczestniczącej, realizowanej podczas kursów specjalistycznych w Centrum Szkolenia OPBMR w SZ RP, a ponadto metody: porównania, analogii, abstrahowania oraz analizy i syntezy.

Wyniki: Wyniki badań ukazują zastosowanie w obu systemach informatycznych unikalnego podejścia do zarządzania informacją CBRN. Zidentyfikowana została również nieznaczna przewaga CBRN Analysis, która wynika z długoletniej obecności produktu na rynku komercyjnym i doświadczeń z tym związanych, ale również zaangażowaniem nieporównywalnych środków finansowych, aby taką dominację utrzymać (w porównaniu z SI Promień). Podsumowując ocenę obu programów, autorzy doszli do wniosku, że SI Promień stanowi optymalne rozwiązanie i zapewnia pełną interoperacyjność KSWSiA i jednolitość funkcjonowania jego podsystemów. Kluczowym zagadnieniem, warunkującym możliwość rozwoju oprogramowania, jest jego kompatybilność z istniejącymi systemami dowodzenia i kierowania oraz certyfikacja SI Promień zgodnie z wymaganiami międzynarodowymi, celem potwierdzenia jego wartości dla rozwoju zdolności obronnych Polski i krajów partnerskich. Analiza programów potwierdziła, że system informatyczny Promień jest w czołówce podobnych rozwiązań o charakterze systemowym oraz ma potencjał w zakresie dalszego rozwoju oraz zaspokojenia bieżących i przyszłych potrzeb KSWSiA.

Słowa kluczowe: zarządzanie informacją CBRN, prognozowanie i ocena sytuacji skażeń, zarządzanie ryzykiem CBRN, zautomatyzowane systemy ostrzegania i powiadamiania o skażeniach

Typ artykułu: z praktyki dla praktyki

АННОТАЦИЯ

Цель: Цель этой статьи заключается в оценке функциональности обеих систем в целях обеспечения ими функциональной совместимости компонентов Национальной Системы Обнаружения Загрязнений и Оповещения (KSWSiA). Задумкой авторов было подтвердить функциональность программы SI PROMIEN по сравнению с другой программой – популярным ИТ-решением для прогнозирования и оценки загрязнения – CBRN ANALYSIS.

Введение: В настоящее время в KSWSiA используются две независимые системы управления информацией о химическом, биологическом, радиологическом и ядерном оружии (ХБРЯ) т.е. компьютерные системы PROMIEN и CBRN ANALYSIS, при этом вторая используется только в Вооруженных Силах Республики Польша. Эволюция ИТ-систем в течение последнего десятилетия привела к развитию современных систем поддержки, которые в состоянии даже заменить человека в области управления информацией и оценке угроз ХБРЯ. Пример такой системы - CBRN ANALYSIS. Он стал источником вдохновения для польских программистов, целью которых было создать современный и эффективный инструмент для прогнозирования ХБРЯ угроз и управления информацией в этой области. На сегодняшний день мы имеем почти 10-летний опыт в области использования и улучшения собственного программного обеспечения, по-прежнему на стадии разработки, что связано с определением новых потребностей и изменений в документах по стандартизации НАТО.

Методы исследования: Исследование было основано на диагностике программ и анализе опыта конечных пользователей. Ключевой задачей было определение детерминантов, которые определяют пользу обоих инструментов в рассматриваемом контексте, а затем их сравнение с использованием размещения. В исследовании использовались методы: участвующее наблюдение, реализуемое в ходе специализированных курсов в Учебном центре OPBMR в Вооруженных Силах Республики Польша, а также сравнение, аналогия, абстракция, анализ и синтез.

Результаты: Результаты исследований показывают, что обе системы имеют уникальный подход к управлению информацией о ХБРЯ. Было также выявлено незначительное преимущество CBRN ANALYSIS, что является результатом долгосрочного присутствия продукта на коммерческом рынке и связанным с этим опытом, а также привлечением больших финансовых средств, для поддержания такой доминанции. В сводной оценке двух программ авторы считают, что SI PROMIEN является оптимальным решением и обеспечивает полную функциональную совместимость и однородность с KSWSiA и её подсистемами. Ключевым вопросом, обуславливающим возможность развития программного обеспечения является его совместимость с существующими системами командования и управления, а также сертификация SI PROMIEN в соответствии с международными требованиями. Компьютерная система PROMIEN доказала, что она находится в авангарде подобных решений системного характера, с огромным потенциалом для дальнейшего развития и для удовлетворения текущих и будущих потребностей KSWSiA.

Ключевые слова: управление информацией о ХБРЯ, прогноз и оценка ситуации загрязнения, управление риском ХБРЯ, автоматизированные системы предупреждения загрязнений и оповещения о них

Вид статьи: с практики для практики

1. Introduction

Nowadays, a number of human activities that can be replaced by computer is increasing year by year. The advantages of such an approach are related to the reduction of labor cost, the increase of work efficiency and avoidance of human errors. In that case any action that can be described by algorithms can be also transformed to the software which will do the same but is faster and provides better reliability. Some rules may be utilized to CBRN contamination management activities. Taking into account the fact that since the accession of Poland to NATO the ATP-45³ is the “bible” of military Warning and Reporting System. The dynamic development of computers has also encouraged the authors of ATP-45 to produce a compliant manual, including equations and algorithms which provide automation of all processes typical for warning and reporting systems that was named AEP-45⁴. Today, it is the fundamental book for programmers. The invention of such a software provides stand-alone capability only. In order to build a network which enables the flow of information between system elements, it was necessary to choose a standard for message formatting. Due to fact that all automated C2 and above class systems use ADatP-3 to ensure interoperability within NATO, the selection of the standard mentioned above was reasonable. Nowadays, there are few software solutions providing ATP-45 approach for automated CBRN hazards data processing and an exchange including CBRN Analysis and SI Promień. The article will be a battleground for both.

2. CBRN Analysis – complex CBRN hazard management system

The first software tool enabling basic features of warning and reporting was the Bruhn Data that was afterwards transformed to NBC analysis and then to CBRN Analysis. It was invented in the late 80's by a retired Dutch army officer who responded to the need for such a system and founded Bruhn NewTech company. The Persian Gulf war was the first combat test for the system when significant quantities of Iraqi chemical weapons and related equipment and materials were located and destroyed. The corporation has grown through the years and now delivers different defense CBRNE class systems. Another opportunity is the fact that Denmark is a custodian of ATP-45 and supports its own industry to promote its products for example, through the organization of computer assisted exercises like BRAVE BEDUIN.

Taking into account the functionalities of CBRN analysis it seems to be close to being perfect. It provides [1]:

- ATP-45(D) and AEP-45(C) calculations based on observations and sensor results;
- CBRN-Analysis calculation of NATO approved Hazard Areas and Contaminated Areas;

³ Allied Tactical Publication (ATP), Reporting Nuclear Detonations, Biological and Chemical Attacks, and Predicting and Warning of Associated Hazards and Hazard Areas.

⁴ Allied Engineering Publication (AEP), Programmers manual for Reporting Nuclear Detonations, Biological and Chemical Attacks, and Predicting and Warning of Associated Hazards and Hazard Areas.

- Full Situational Awareness of CBRN Picture;
- Map based display of CBRN with conversion tool for range set of GIS products;
- Information and overview of assets at risk;
- Optional interface to dispersion models providing detailed hazard estimates;
- Support for HPAC⁵/JEM and HAPPIE models for COI;
- Modules for allowing CBRN Information Management including Sensor Integration, Computerized Assisted Training, Language conversion and Decision Support.

Over the 20 years of CBRN analysis software development, it brought a user-friendly interface shown in a picture below and highly reliable output.

3. SI Promień – national approach to automation of National Warning and Reporting System

This would be a desired solution for everyone but the high cost of a single-desk license (c.a. 20 000 EUR) seems to be the main reason to start thinking of the development of our own system. Moreover, if we consider the obligation of providing the platform for National Warning and Reporting System (KSWSiA) and the assumption that software is the binder of system cells belonging to different ministries and services, it is a justified circumstance to develop a national system. The question is who will do that, who will pay for it, and who will be responsible for the implementation. The correct answer is the Minister of National Defence and its subordinate institutions. It is reasonable because of the fact that it coordinates the activities of NW&RS and the military W&R system which was the protoplast of the nationwide system. The work on project Promień was initiated almost 10 years ago and it is definitely still not finished. Mostly used version 2.3 is compliant with ATP-45 (B), however version 3.0 based on ATP-45 (D) is being consequently introduced in KSWSiA. Considering the CBRN Analysis as the reference system that is certified and approved for use in NATO C2 systems, system Promień is few steps behind. The reason is the requirement of compatibility with outdated SZAFRAN decision support system, use of former generation PGO⁶ as mapping engine and non-user-friendly ADatP-3 editor. However, taking into account the limited number of programmers, BEAM provides the expected functionality to report and warn military and civilian entities of the system. Its main features are as follows:

- Generation, storage and management of CBRN reports compliant with ADatP-3
- Exchange of information via built-in or external client e-mail and related warning and CBRN reporting after incidents
- Portraying of CBRN reports, troops, and objects (e.g. chemical processing facilities) providing situational awareness and CBRN picture based on PGO and military GIS products
- CBRN calculation of hazard and contaminated areas

⁵ Hazard Prediction and Assessment Capability/Joint Effect Model – advanced modeling tools for CBRN hazards sponsored by US DTRA and developed by Optimetrics Inc.

⁶ Operational Graphics Suite.

- Information on assets in defined contaminated areas
- CBRN defense assets management

From the perspective of the system operator, BEAM requires at least average computer skills to install and configure software, database and MS Windows services. The Promień training should be followed by PGO instruction to fully utilize combined advantages of both tools, e.g. for casualty estimation.

The basic skills can be achieved after a week training, however the advanced skills require twice as much time and a completed CBRN hazard assessment course prior to Promień one. Instructors also suffer from lack of dedicated design mode exercises similar to those available during CBRN analysis support training preparation. The user

interface is shown below and seems to be simple, clear, and useful. Only ADatP-3 editor which was mentioned before downgrades the overall assessment. The formatting of messages requires a long trip through all fields and almost investigation skills to find appropriate input value. The most important report (CBRN3) used to warn threatened units usually contains correct values. All identified mistakes in plots are corrected by programmers and patches are delivered to software users as soon as possible. Calculated areas are put in the correct fields and, if operator tasks the system, are transmitted to PGO as a set of MGRS coordinates and a way they should be linked is also presented. The final output depends on PGO capabilities which influence efforts of programmers to optimize the code.

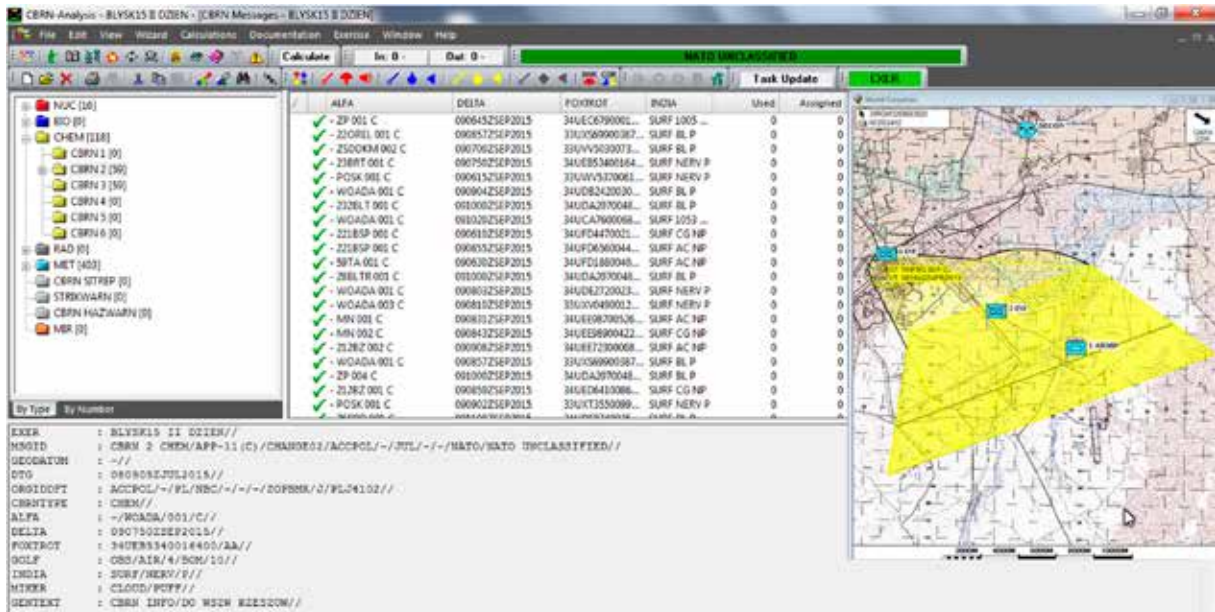


Fig. 1. CBRN Analysis user interface [2]

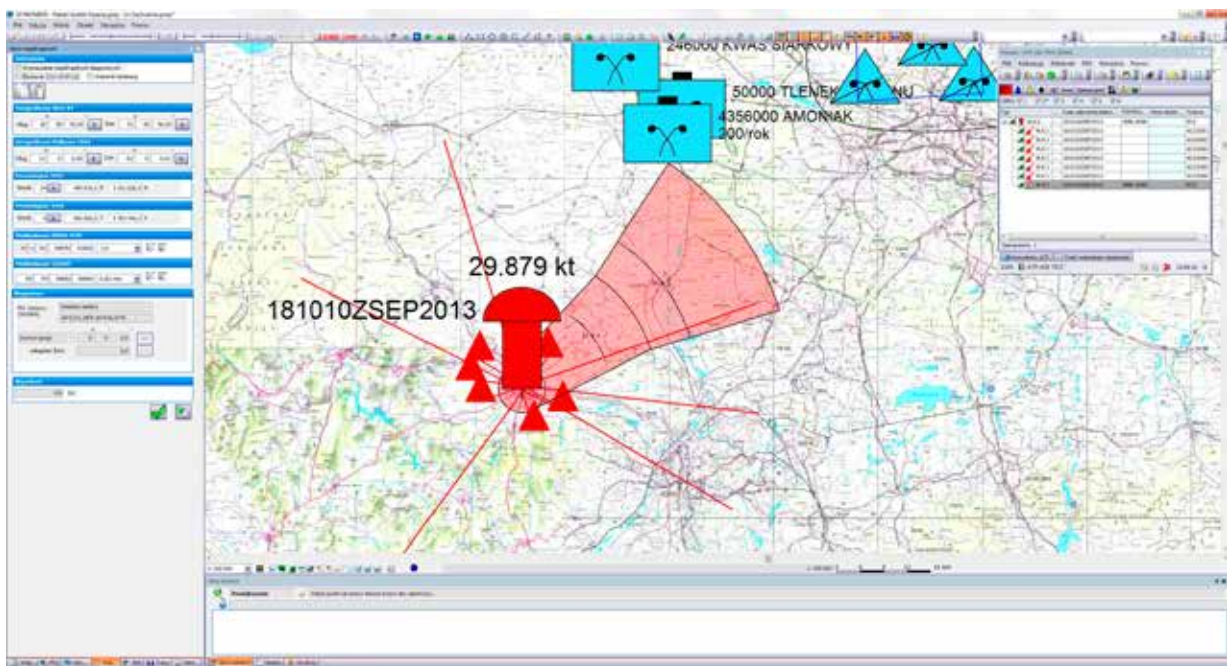


Fig. 2. SI Promień v.3.0 user interface
Source: Own elaboration.

Apart from compliance with ATP-45, both systems have their unique features that can be a decisive point for those who consider to own one of them. CBRN Analysis seems to fulfill all requirements but the selling policy and available budget encourages to make further investments into SI Promień and limit number of granted CBRN

Analysis licenses only to those institutions that are intended to cooperate with other NATO assets. In order to have better view of both system, it is reasonable to present a comparison of their features. The table below provides the most important specification of their advantages and disadvantages.

Table 1. Comparison of CBRN Analysis and SI Promień basic features

FEATURE	CBRN ANALYSIS	SI PROMIENŃ
Compliance with ATP-45	Confirmed and certified, up to Echo edition	Not certified yet, currently Delta edition, version 3.0
Source level management	Provided by SCIM software and hardware solution	Will be implemented within BEAM-Z system in the future
Mapping	Requires conversion be built-in tool; user data can be placed on created layers	Can work with all GIS national military products; powered by PGO; user data can be placed on created layers
Exchange of information	Built-in and external e-mail client, approved to be used in NATO C2 classified networks	Built-in and external e-mail client, certified only to MILWAN up to restricted level
Warning of assets in danger	Limited to CBRN hazard areas, enabled automated warning	List of personnel and resources in manually selected or CBRN3 zone
Link to advanced models	HPAC/JEM, HAPPIE	None
Language	English, Polish on request	Polish
Quality	Outstanding	Good
Cost	High, depending on number of licenses	Sponsored by MOD
Overall assessment	Very good	Good

Source: Own elaboration.

SI Promień is currently under implementation in KSWSiA. Having your own, maybe not perfect but useful system, gives opportunity to gain new experience and slightly, step by step, enhance its capabilities. One of the key factors seems to be the cutting-edge simulator designed to train operators of KSWSiA. Its usage increases training efficiency and provides capability of multilevel preparation of exercises.

4. Summary

Today, SI Promień seems to be a great investment, despite some disadvantages. Ongoing implementation of version 3.0 based on ATP-45 (D) and PGO ed.2014 will bring the system to the top. The future enhancement of SI Promień capabilities by implementation of source level detector networks, will significantly increase system usability. Certification of SI Promień as a system compliant with NATO standards for hazard assessment and information exchange should be the next step. In the future it is expected that SI Promień will replace CBRN Analysis and become the leading solution.

Literature

- [1] CBRN Analysis 2013, <http://www.bruhn-newtech.com/docs/CBRN-Analysis-2013.pdf> [access on 28 December 2013].
- [2] CBRN Analysis, <http://www.bruhn-newtech.com/defense/cbrn-analysis.php> [access on 28 December 2013].

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Areas of interest:

- CBRN defence in armed forces and civilian society,
- hazard prediction of CBRN incidents (manual and computer procedures),
- risk management.

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Areas of interest:

- CBRN defence in armed forces and civilian society,
- collaboration between military chemical troops and fire forces in decontamination process,
- physicochemical separation methods.

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Areas of interest:

- CBRN defence in armed forces and civilian society,
- hazard prediction of CBRN incidents (manual and computer procedures),
- carriage of dangerous goods by road.