

Problems summary of Czech National Medicines Verification System (CZMVS) and their solution from April to July 2019

There were no significant complications in CZMVS experienced during the first months of its operation. The main problem was a high number of alerts in verifying medicines. The slight optimism about a decreasing number of alerts was stalled by the failure of the CZMVS function during April to July 2019, which caused a slower response time and, in some cases, even the inability of end users to verify and dispense medicines. The National Medicines Verification Organization (NOOL, z.s.) very intensively handled these problems with the IT solution provider - Solidsoft Reply. Similar problems have so far occurred only in the Czech Republic, which may be due to the highest number of transactions performed in the Czech verification system as compared to the number of transactions performed in other EU Member States that are customers of Solidsoft Reply. These problems have been gradually identified and handled. The situation is currently stabilized, but all elements of the solution are being verified and gradual actions to identify and correct other potential reasons for a slow system response have been taken.

The European Medicines Verification System is a very complex and most complicated project launched on the pharmaceutical market. Problems with its implementation were expected and this is why, the law in the CR set up a transitional/trial period until the end of 2019 to debug the National Medicines Verification System in order not to compromise the availability of medicines.

The test operation of the Czech National Medicines Verification System (NMVS) started during the year 2018 and the regular operation was launched on 9 February 2019.

The main problem since the very beginning was a high number of alerts, the majority of which was caused by incompliance between data uploaded by marketing authorization holders (MAHs) and data in the unique identifier (2D code) printed on medicine packaging. Some errors are also caused by end users (a wrong setup of scanners, typing Y instead of Z and vice versa, typing lower-case letters instead of upper-case letters and vice versa). Almost all errors were formal mistakes that do not indicate any potential falsified medicines. The decreasing number of alerts sparks some optimism.

CZMVS failures

A blanket delay in the response time in verifying medicines occurred in the first half of April (the first incident occurred on 10 April 2019). The problem then appeared several times. The situation worsened starting on Wednesday, 22 May 2019, when the main database was disconnected (from 9.00 a.m. to 12.00 p.m.) and the majority of end users lost access to the system. With the exception of this three-hour failure, the operation of the entire system was never interrupted. However, some end users experienced a longer response time taking up to tens of seconds, sometimes the system was unavailable to users (request time-out). Different end users with different IT systems experienced problems and their intensity fluctuated. Problems with availability also occurred on 24 May and 27 May 2019.

Due to an error during the troubleshooting (a complete system restart) performed by Solidsoft Reply, the failure also affected manufacturers (MAH/OBP) who could not deploy and update data in EU-HUB into the Czech NMVS from 25 to 29 May.

Some problems (short-lasting and much smaller) also occurred during the month of June (5, 6, 13, 14, 18, 20 and 21 June 2019).

Actions taken by NOOL

As soon as the first problems with availability occurred, NOOL discussed them with Solidsoft Reply (the provider of the IT solution for medicines verification on the European level). NOOL was gradually able to get attention of Solidsoft Reply's highest management, the European Medicines Verification Organization (EMVO) and the European Federation of Pharmaceutical Industries and Associations (EFPIA) to be involved in the problem. Although all other EU Member States use the identical version of the system, the problem occurred only in the Czech Republic that, however, has the highest number of transactions from among Solidsoft Reply's customers.

An intensive identification of potential reasons for the system problems took place. First, it was not clear where the problem was and therefore, many different hypotheses, such as application errors, infrastructure problems and even a targeted attack from the outside, were verified and gradually eliminated. The list of activities is provided below.

NOOL's findings and activities

April 2019

- The search for reasons for the initial incident focused on the configuration of transmitting transaction requests between system nodes; after the reconfiguration, the problems stopped almost for a month.

May 2019

- The problem with a slow system response was gradually escalated to Solidsoft Reply's management and crisis conference calls took place on a daily basis.
- The European platform (EMVO) was informed and the EMVO's management got involved. There were repeated conference calls monitoring the progress of searching for a solution.
- Several local software firms and end users were asked to cooperate, some of them provided NOOL with records of transactions from the critical time periods.
- A problem report requiring the acceptance of results, including CAPA – corrective and preventive actions, prior to closing was created.
- **A monitoring tool to monitor the availability of the national system was created.**
- SolidSoft Reply repeatedly handled the database failure with Microsoft. The system in the current configuration was re-uploaded (on 24 May 2019 between 7.00 p.m. and 11.00 p.m.).
- However, problems occurred again on 27 May 2019, which meant that the previous actions did not identify the actual cause(s).

June 2019

- Some partial problems with the system response were experienced again during the month of June (smaller problems than the ones in May). SolidSoft Reply carefully monitors the Czech market and gradually restarts parts of the system upon any indication of a problem (an increasing number of blocked fibers) (this, however, does not affect the operation of the NMVS). This is why, there have been no serious long-lasting problems.
- Solidsoft Reply performed several corrective actions (the size of the application RAM was increased, changed the script for assigning sources to individual nodes, changed the expiration time of the application cache).
- Solidsoft Reply created a new testing environment for the stress tests simulating better the behavior of users in the system (a faster start of system stress in the number of transactions



during one minute, a combination of transactions, taking into consideration a higher share of intermarket transactions, etc.).

- Performed stress tests identified and then confirmed as one of the main reasons for problems with uploading the configuration script upon every API inquiry in the JSON schema.
- A corrective program release that handled mainly the aforesaid problem with the JSON schema was created and started (23 June 2019 – only for the CR).
- Several other reasons for the slowing down of the system were discovered and gradually corrected.

Current actions and a further course of action

- Individual components and solution parts are gradually verified in order to isolate the problem and to confirm the reason.
- The size of memory (RAM) was increased on 21 May 2019.
- All application components were re-deployed in order to eliminate a potential error or a change in the application code and to get the CZMVS running as soon as possible – 24 May 2019.
- Configuration changes in the setup of the cluster for the NMVS were made.
- The time for clearing the application cache was increased (cache memory was optimized).
- **On 28 May 2019, NOOL launched its own monitoring system of the NMVS, including an on-line display of the CZMVS status on NOOL's website - <https://www.czmvo.cz/cs/stav-nsol/>.**
- Since 24 June 2019 (after the deployment of the JSON configuration was corrected), the NMVS has been working without any problems, occasionally the response is longer during night and early morning hours. The reason is being investigated.
- Long-term stress testing in a new simulation environment is being performed in order to identify other potential problems.
- Corrective and preventive actions (CAPA) have been approved. NOOL regularly monitors their fulfillment by Solidsoft Reply.

NOOL would like to thank everybody, who is helping to resolve the problem and is providing information, and to apologize for the complications caused to pharmacies and distributors due to the CZMVS failure.



Corrective and preventive actions (CAPA) based on Solidsoft Reply's report

NOOL reported small or unsuccessful transaction timeouts at the site of end users from the middle of April to the middle of May 2019. In attempt to resolve the problem the size of the application memory (RAM) on impacted system nodes was increased and these nodes were restarted, but this did not resolve the problem.

Microsoft's database CosmosDB was unavailable in the Czech system on Wednesday, 22 May 2019; the database capacity was increased.

The analysis of process databases continued during the incident and later on; on the same day, it was discovered that a large number of the processor capacity was used by requests to read configuration data. This shows that the system was unable to upload these data from the cache of configuration data. At the same time, a correlation between the expiration of cache configuration data and the loss of system performance was discovered.

Another analysis showed that every request for data configuration in the database required to open one or several processor "fibers." This blocks the availability of fibers for other processes while a response from the database is expected. The system is able to create other fibers but with a certain time delay, which decreases its performance. In order to resolve these problems, the expiration time of the cache for configuration data was extended from 15 minutes to one year, which helped to recover the expected level of performance during the next few days.

The analysis of dumps continued and discovered that the blocking of fibers was also caused by the process designed to verify the format of incoming transaction messages required by the JSON schema for every transaction.

Solidsoft Reply modified performance tests to see better the behavior of the JSON schema in the Czech environment. For instance, on 12 and 13 June 2019, the Czech system processed four times more daily transactions than the second largest system (Sweden).

Solidsoft Reply did not find any other causes but will continue to monitor the system behavior and to modify and develop the testing environment to simulate situations in real operation, including changes and increases in inquiries and transactions.

Prepared based on Solidsoft Reply's report