

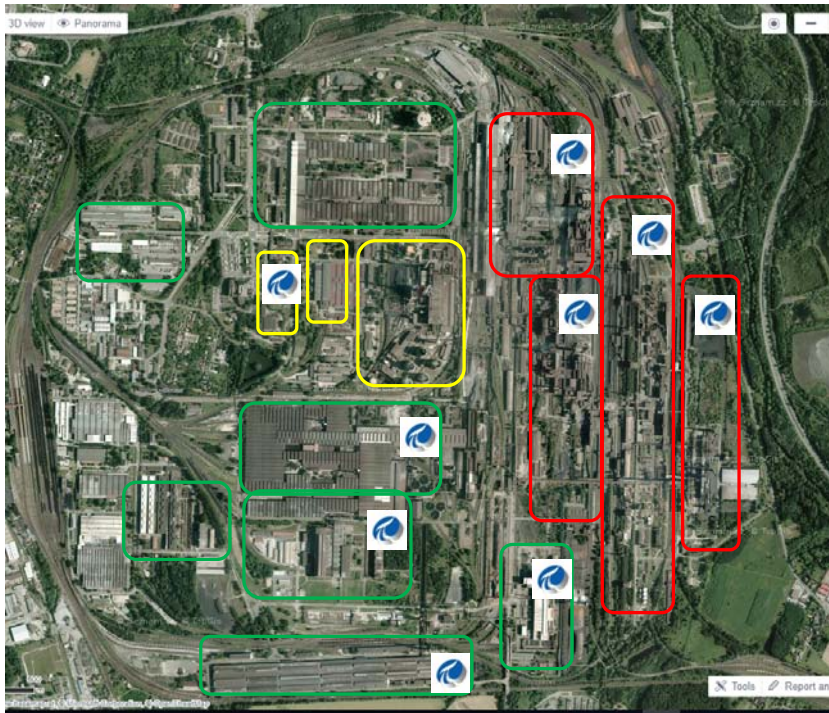


# Condition-based maintenance via PI System




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October 2020



# LIBERTY Ostrava — complex metallurgical process







## Primary

-  Coke plant
-  Blast furnaces
-  Steel plant

## Services

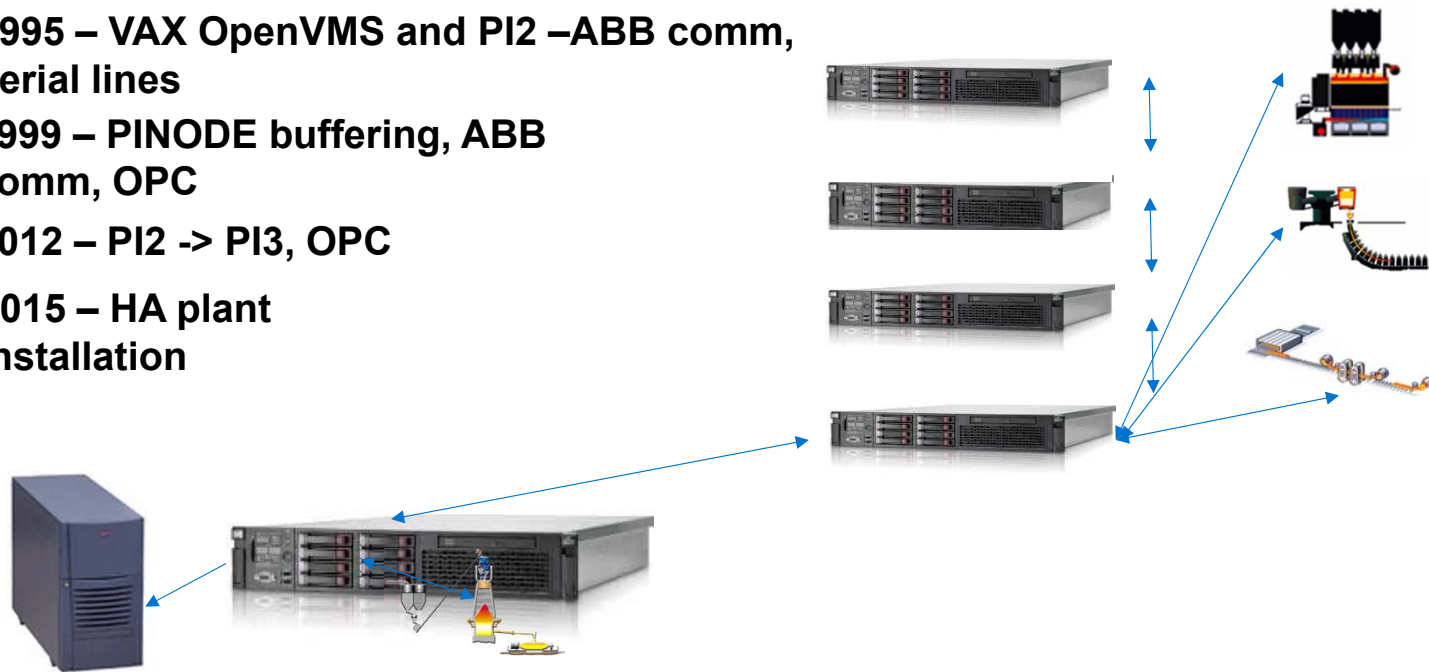
-  Power station
- Engineering products
-  Labs

## Secondary

-  WR and HCC mill
-  Middle section mill
-  Flat products mill
-  Cutting lines
- Tubulars
- Foundry
- Road barriers

# Ostrava's PI system history

- 1995 – VAX OpenVMS and PI2 –ABB comm, serial lines**
- 1999 – PINODE buffering, ABB comm, OPC**
- 2012 – PI2 -> PI3, OPC**
- 2015 – HA plant installation**



The communications with other systems (labs, environmental systems) followed described changes

# PI and Maintenance



## Challenge

- Automatic decision system for CBM
- Event and alarm system for preventive maintenance
- Predictive maintenance

## Solution

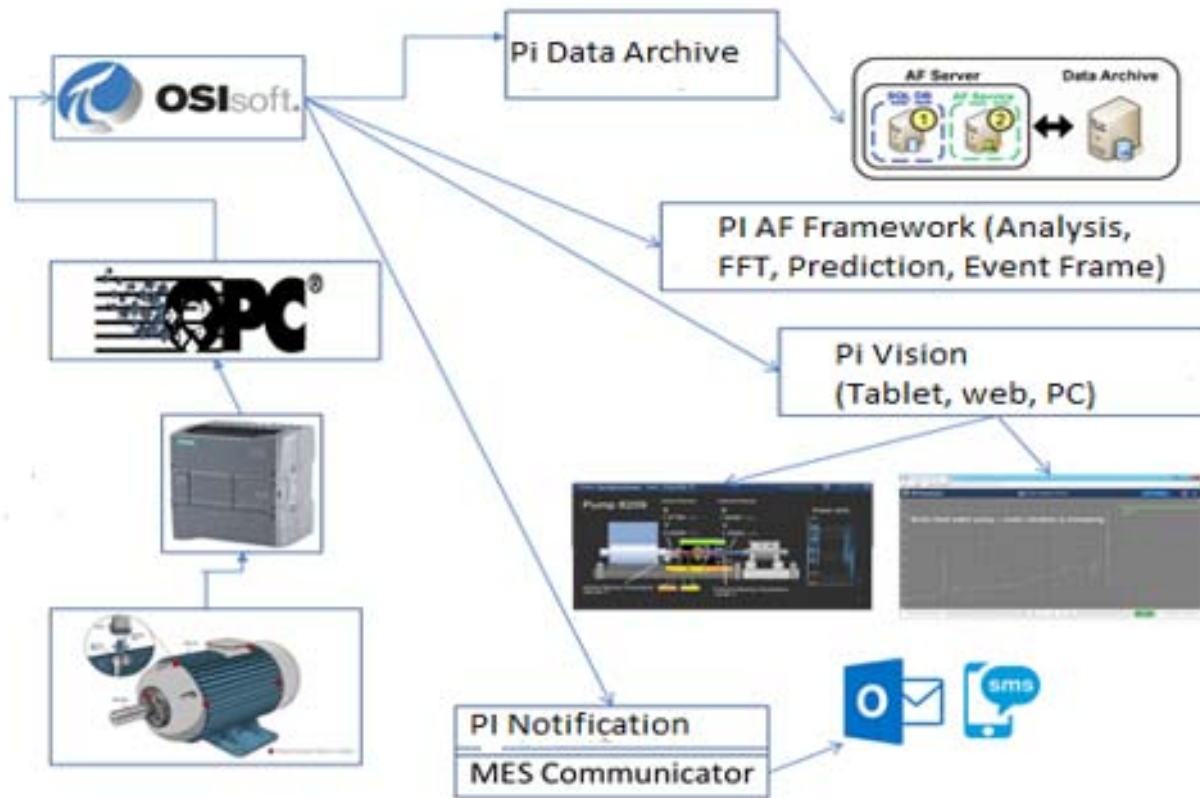
- Internal app develop based on PI System
- PI System data and triggers to application
- Predictive system based on PI System

## Benefits

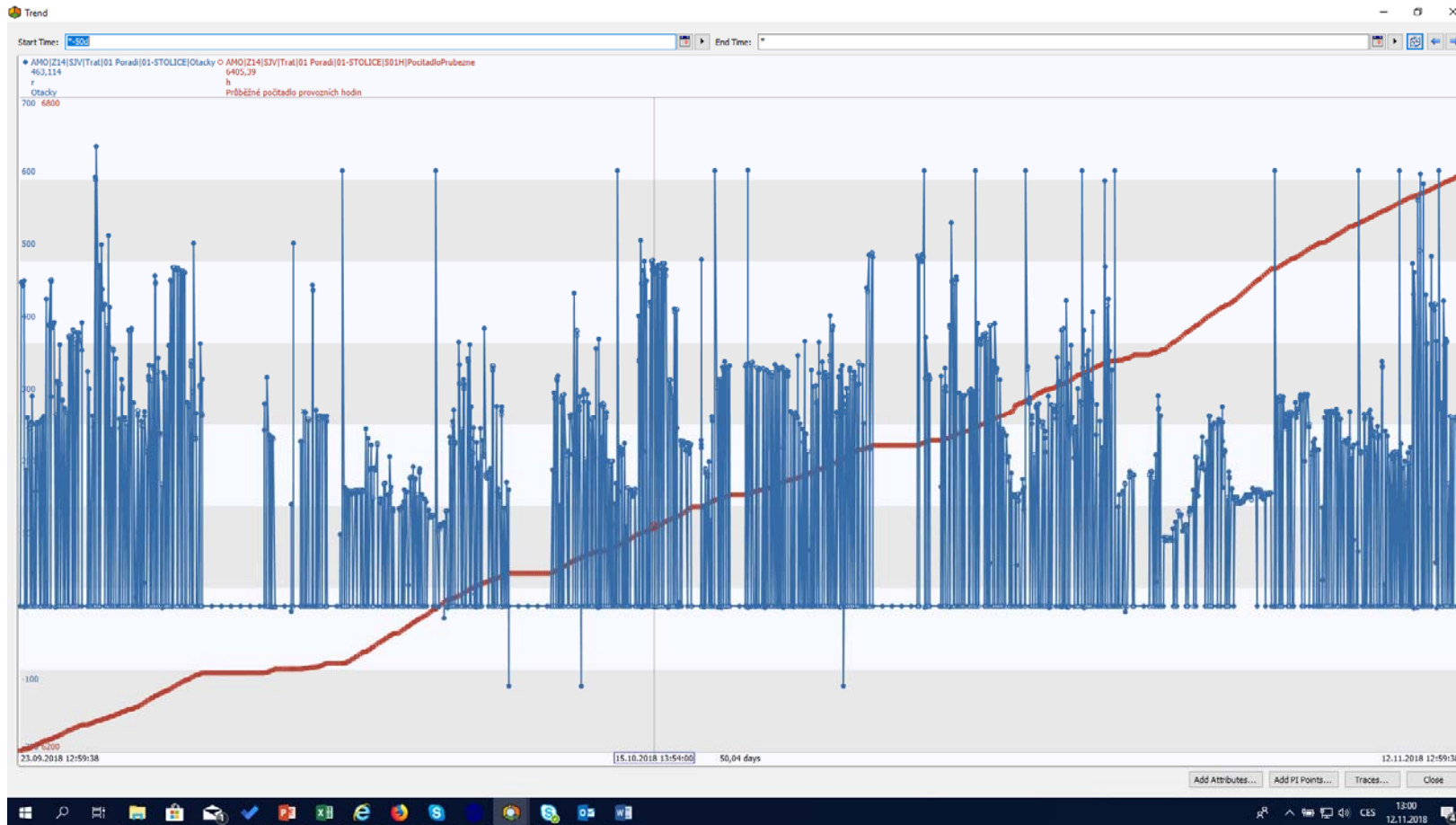
- FTE saving, avoid mistakes in process, H&S increasing
- Avoid loses in production approx 10%
- Just in progress

# PI and Maintenance – CbM - Lubrication of devices

Realisation of data flow



# PI and Maintenance – CBM - Lubrication of devices



## Working time calculation

Based of electric current or engine spin the working time is calculated (red line)

# PI and Maintenance – CbM - Lubrication of devices



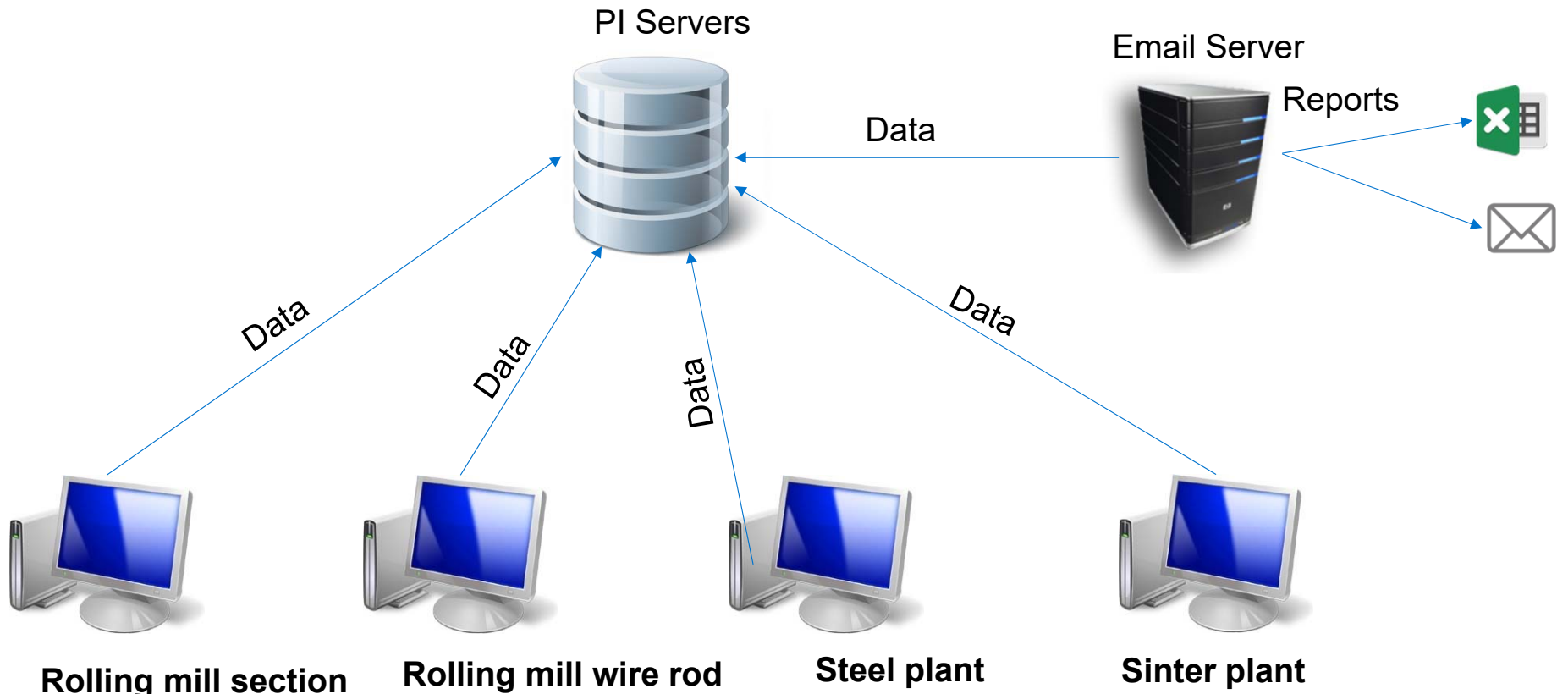
Base data

Working time between lubrication

Total working time

Reset after lubrication

# Current architecture





## Current situation - description

- All data stored in PI Server databases
- Clients - applications in the form of thick clients on user PCs. To start and verify it is necessary to install PI System + to load the user into the PI system. The user can view data, enter data, export reports, monitor Event Frame or PI Vision applications
- User management - we have established user groups based on AD
- Email server - processes data from PI servers, creates text / Excel reports

## Current methods

All methods of connecting to programs are from **OSIsoft.AFSDK**.

- Individual maintenance points are represented by **AF Elements**
- Using PI Analyses, the continuous operating hours in the load range are calculated.
- This data is visualized in several ways by a client application in **C # WPF**.
- User inputs are written as **AF Values** using **Update Values** in the **PI Data Archive** - in our case in both **PI Collective Members**.
- Events used to generate **Event Frames** are defined. Event Frames are triggered by the so-called Stack Trigger. Currently, two Event Frames are available to users:
  - **Time between maintenance** (how long has passed since the last lubrication)
  - **Waiting for maintenance** (is the time when the device had exceeded the maintenance interval) – Event Frames are triggered by the so-called Stack Trigger.

## Current methods

- Display of data from Event Frames as reports
- Display of data from Event Frames graphically using PI Vision
- Excel reports and lists are generated from the data
  - Weekly overview
  - Recommended lubrication schedule
  - Warning for non-maintenance
- These reports are regularly emailed to the users responsible for the area

# Main page for Sinter plant

USER: OVHUT\N029383; SERVER: INH-APP-AFSRV01.ISPATCEE.COM; DATABASE: Z45 Database Test; NODETYPE: CbM Aglomerace Mazani; DATE: 28.09.2020 11:45; VERSION: 1.0.5

Plan Údržby | Online Měření | Provedena Údržba

- ↳ MlyniceKoksu
- ↳ OdsunAglomeratu
- ↳ PrisuPodavaciStoly
  - ↳ M601
    - ↳ TrubkoretezoVyL
    - ↳ HnaciStanice
    - ↳ VratnaStanice
  - ↳ M602
    - ↳ SnekovyDopravn
    - ↳ Pohon
- ↳ S01
- ↳ S02
- ↳ S03
- ↳ S05
- ↳ S06
- ↳ S07
- ↳ S08
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- ↳ S18
- ↳ S41
- ↳ S51
- ↳ S53
- ↳ S59
- ↳ S63
  - ↳ MichaciBubenl
  - ↳ PohaneStari
  - ↳ Soukoli
- ↳ S81
  - ↳ PasovyDopravn
  - ↳ PohaneStari
  - ↳ PruvesnaNař
  - ↳ VratnaStanice
- ↳ S84
- ↳ S85
- ↳ S87
- ↳ S88
- ↳ S89
- ↳ SpalinovyFiltr
- ↳ Test

Kaniok, Marcel  
36  
508  
**HnaciBuben**

Kondiolka, Milan  
-244  
508  
**PrevodovaSk**

Valicek, Tomas  
7  
508  
**PrevValecHn**

Valicek, Tomas  
-93  
508  
**SpojkaVPS**

### PohaneStanice - Prevodova skrin

**INFORMACE**

Celkové dny/Dny do výměny : 508                      -244

Počet výměn/Time Stamp : 3                                      01.11.2019 03:26

Poslední výměnu zadal/Time Stamp : Kondiolka, Milan                      01.11.2019 03:26

**VLOZENI**

Zadej ins. data:    :  :

**HISTORIE**

Čas mezi výměnou			
Začátek	Konec	Č. inspekce	Insp. zadal
01.11.2019 03:26	20.01.2020 07:32	3	Kondiolka, Milan
29.09.2019 18:36	01.11.2019 03:26	2	Manak, Libor
27.06.2019 09:49	29.09.2019 18:36	1	Pt Created
02.04.2019 13:30	02.04.2019 13:43	0	Pt Created

Čekání na údržbu		
Začátek	Konec	Č. inspekce

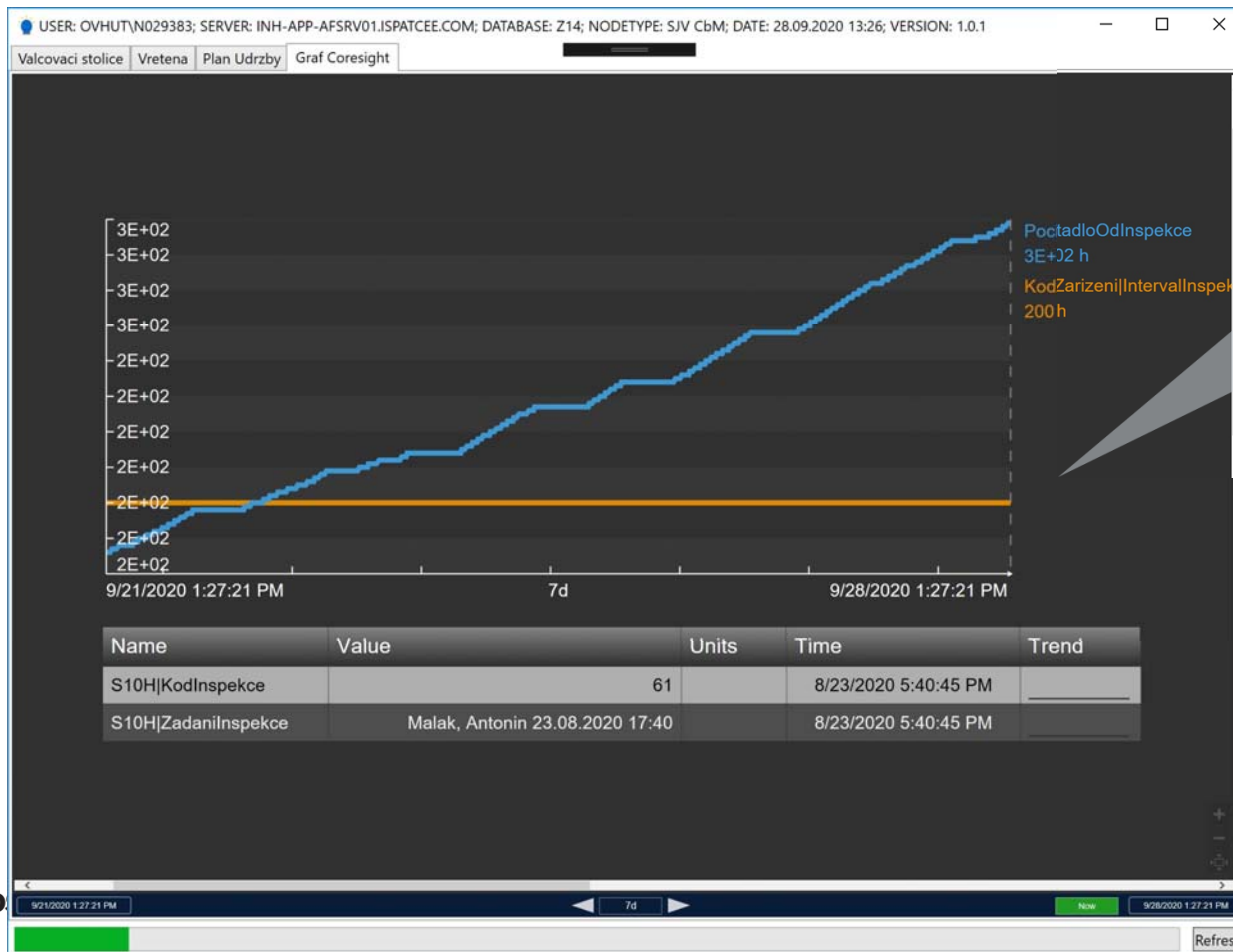
Vkladani inspekce

View information about the logged in user, PI server, and dataset.

Displays the detail window of the element. It is possible to insert a maintenance record, look at the maintenance processes in the form of Event Frames.

Display of individual elements using a tree structure corresponding to the individual physical arrangement of the line.

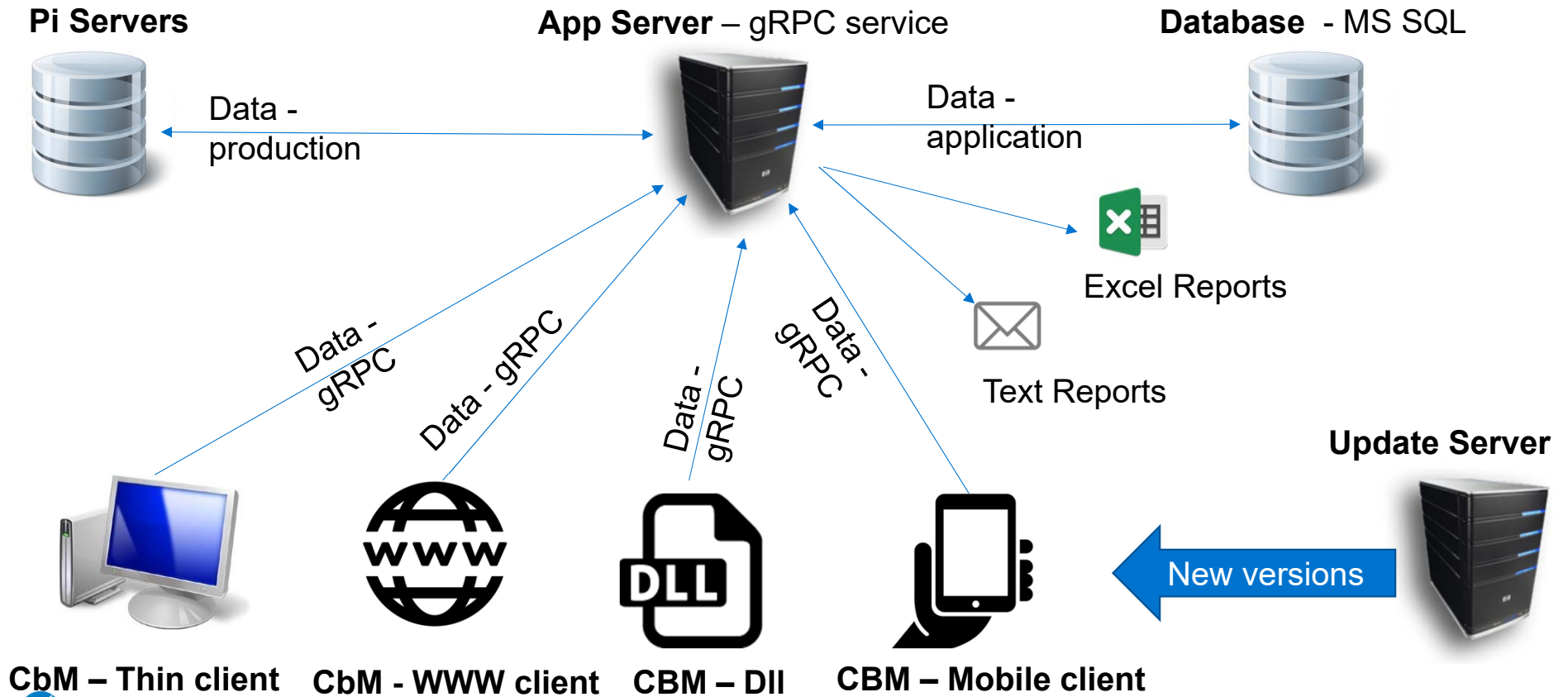
# Rolling mill – sections – PI Vision report



Pages displayed in kiosk mode for the rolling mill. It is possible to use the change of the interval of displayed data here.



# Future architecture



## Future architecture

- The server will also implement business logic for creating emails and attachments in the form of xls, txt. And send them to the appropriate user groups.
- Users will use a range of thin clients - in addition to existing WPF desktop applications, it will also be a client in the form of a website (asp.net), a native mobile application, a dll library for integration into third-party software.
- By defining endpoints using the gRPC protocol, the client application is not dependent on any specific technology or development environment and is faster than Web API
- Update server - will be the only place where current versions of programs (thin clients) will be displayed

# Next steps

Integrate PI System with professional maintenance system contain CMMS, Prediction and Prevention tasks

CAPEX project



Enlarge current benefits as :

- FTE saving
- Process reliability increasing
- Costs savings
- Spare parts supplies decreasing



## Hierarchy Structure

- MRO - Integrated Operations
  - Check Plant (Test)
    - Maintenance
      - Check Plant Common
        - 1st Plant
          - Maintenance
            - 1st Plant Inspection Facilities
              - Production Facilities
                - Maintenance
                  - BEA - Bead Process
                  - BUI - Building Process
                  - CAL - Calendaring Process
                  - CLUR - Curing Process
                  - CLUT - Cutting Process
                  - EXT - Extruding Process
                    - Maintenance
                      - EXTAU - EXT AUX\_EQ
                      - MIX01 - MIXER #01(Test)
                      - SKXT01 - S-EXT #01
                      - TDXT01 - TREAD EXTRUDER
                        - BOM - Bill of materials
                          - Maintenance
                            - 01 - feeding device GE120
                              - BOM - Bill of materials
                              - 01 - monitor
                              - 02 - belt conveyor
                                - Maintenance
                                  - 01 - frame
                                    - BOM - Bill of materials
                                    - Maintenance
                                      - 01 - frame 3560\*1210\*200
  - BOM - Bill of materials

## Maintenance Objects Categories

- Plant – plant location – provides basic information about the plant
- Functional location – used for manufacturing processes
- Equipment – one functional unit
- Sub-equipment – parts of equipment / machinery operating separately
- BOM – Bill of Material – material / parts installed

## Document Management

| Int | Label | Description | Created by        | Checked by        | Released by       | Rev | Add | Red |
|-----|-------|-------------|-------------------|-------------------|-------------------|-----|-----|-----|
| 1   |       |             | 12.06.2018 / SITH | 11.06.2018 / SITH | 12.06.2018 / SITH |     |     |     |

## Operational Info

| Initial start time  | Initial end time    | Shutdown start      | Shutdown end        | Completion start time | Completion end time | Shutdown for           |
|---------------------|---------------------|---------------------|---------------------|-----------------------|---------------------|------------------------|
| 2018-12-18 08:26:33 | 2018-12-18 24:26:55 | 2018-12-18 09:26:03 | 2018-12-18 14:28:03 |                       |                     | +MRO.F.PL.P.MIX        |
|                     |                     | 2018-12-18 07:00:57 | 2018-12-18 12:03:00 |                       |                     | +MRO.F.P9              |
| 2018-12-18 07:11:53 | 2018-12-18 24:31:56 | 2018-12-18 07:01:53 | 2018-12-18 14:02:56 |                       |                     | +MRO.F                 |
|                     |                     | 2018-12-17 18:08:28 | 2018-12-17 18:08:28 | 2018-12-18 12:46:57   | 2018-12-20 24:46:52 | +MRO.F.PL.P.EXT.#00701 |
| 2018-12-17 21:29:33 | 2018-12-20 11:39:42 | 2018-12-17 11:39:33 | 2018-12-20 11:39:42 |                       |                     | +MRO.F.PL.L            |
|                     |                     | 2018-12-13 19:23:01 | 2018-12-13 22:02:02 |                       |                     | +MRO.F                 |
|                     |                     | 2018-12-12 21:42:47 | 2018-12-12 22:43:54 | 2018-12-18 14:22:59   | 2018-12-20 24:42:52 | +MRO.F                 |
| 2018-12-07 08:15:46 | 2018-12-28 08:15:47 | 2018-12-07 08:15:46 | 2018-12-28 08:15:47 |                       |                     | +MRO.F.PL.L            |



# Thank you

謝謝  
 DZIĘKUJĘ CI  
 NGIYABONGA  
 TEŞEKKÜR EDERİM  
 DANKIE  
 TERIMA KASIH  
 SPASIBO  
 ПАСИБО  
 GRAZIE  
 МАХАДСАНИД  
 GO RAIBH MAITH AGAT  
 БЛАГОДАРЯ  
 GRACIAS  
 ТИ БЛАГОДАРАМ  
 TAK DANKE  
 RAHMAT  
 HATUR NUHUN  
 PAXMAT САГА  
 CÁM ƠN BẠN  
 WAZVIITA  
 TAPADH LEIBH  
 KEA LEBOHA  
 БАЯРЛАЛАА  
 MISAOTRA ANAO  
 WHAKAWHETAI KOE  
 DANKON TANK TAPADH LEAT  
 MATUR NUWUN  
 ХВАЛА ВАМ  
 MULȚUMESC  
 GRAZIE  
 고맙습니다  
 SHUKRA  
 HVALA  
 FAAFETA  
 ESKERRIK ASKO  
 HVALA  
 TEŞEKKÜR EDERİM  
 OBRIGADO  
 DANKJE  
 ΕΥΧΑΡΙΣΤΩ  
 GRATIAS TIBI  
 AČIŪ  
 SALAMAT  
 MAHALO IĀ 'ŌE  
 TAKK SKALDU HA  
 ДЗЯКУЙ  
 MERCI  
 DI OU MÈSI  
 ĀKIJEM  
 GRAZZI  
 PAKKA PÉR  
 ありがとうございます  
 SIPAS JI WERE  
 TERIMA KASIH  
 UA TSAUG RAU KOJ  
 TI БЛАГОДАРАМ  
 СИПОС  
 KÖSZÖNÖM  
 GRACIES  
 SALAMAT  
 MAHADSANID  
 MAHALO IĀ 'ŌE  
 DZЯКУЙ  
 FALEMINDERIT