23/04/2012

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# Operational PIMS: The PI System at Vale, as the Only Data Source to the Enterprise System

# Why are we here?

**Summary:**

- I am Luiz Henrique,
- I am Luciane,
- I am Álvaro

We are from Vale-Brazil and have come here to learn and share with everyone our success in Brazil.

**Objective:**

We want to show you the use that we make of a very important tool – the PI System – for the operational world. It aims to increase profits and reduce costs and time...



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# Agenda

We will introduce you to Vale - Pride of Brazil;

We will talk about the computational structure ready for the PI System;

We will present an innovative success case (for Vale);

Future vision for the use of the PI System.



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# About Vale

# Vale around the world

Headquartered in Rio de Janeiro, Brazil, Vale employs a global workforce of over **170,000 people**. Our mining operations, research facilities, projects and offices extend across **38 countries**.

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# Our business

- **Research**
  Cutting-edge research in geology, processing, engineering and social economical and environmental technologies helps Vale create forward-looking technology to improve efficiency and find more responsible ways to discover, mine and deliver minerals.

- **Mining**
  Transforming raw minerals into the ingredients essential for everyday life is the core of our business. From familiar staples such as iron ore and nickel to increasingly-important additives such as manganese and potassium, we continually work to set new standards of excellence in extraction and production.

- **Logistics**
  Vale moves more than 26.176 billion tons of cargo every year through Vale-managed railways, ports and marine transport services. This distribution network enables Vale to reduce the time and cost required to transport minerals and other goods.

- **Energy**
  At Vale, reliable energy is vital to our mining operations. We invest significantly in renewable hydro-electric generating projects and other clean alternatives that reduce our dependence on fossil fuels. This is just one of the ways we focus on low impact,
  sustainable operations.

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## Our Vision

- To be the number one global natural resources company in creating long term value, through excellence and passion for people and the planet

## Our Values

**Life** matters most
Value our **people**
Prize our **planet**
Do what is **right**
**Improve together**
**Make it happen**

***Does not have future without mining.***
***And does not have mining without think in the future.***



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## Mining, the core of Vale's business

The discovery and transformation of minerals is the core of Vale's business. Companies around the world depend on the production from Vale's mining operations to create the products people use every day of their lives.

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# Mining, the core of Vale's business

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**Paper production** dishes **Paint mixtures**

**Industrial fuel** Power generation **Steel making**

**Agricultural fertilizer** Garden fertilizers

Batteries **Stainless steel** House paint

Bicycle rims **Commercial airlines** Cooking foil **Civil construction** Beverage cans

**Microchips** Televisions **Electric power lines**

**Aircraft turbines** CDs/DVDs **Medical Instruments**

**National currencies** Magnets **Computer hard disks** Cooking utensils

**Railroad tracks** Ballpoint Pens **Skyscrapers** Faucets

**Heating/cooling duct work** Staples **Factory robotics** Mobile phones **Sewer systems** Frames for eyeglasses **Telecommunication networks**

**Bulldozers** Rulers **Automobile** Overhead power lines **Fire hydrants** Clothing zippers



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# Operating revenue breakdown in 2009

**Iron ore and nickel represent a major part of the company's operating revenue**



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## Iron Ore - Vale

*Billion ton*

| | Reservation* |
|---|---|
| South and southeast System | 4.3 |
| North System | 5.1 |

**TOTAL** **9.4 billion tons**

* AMEC AUDIT 2009



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# Iron Ore Area

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# And the PI System?!? Where is it in this context?

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## We need to change...

# “NO PAIN NO GAIN”

jpazcury@globo.com



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## Information x  Importance

- Information is absolutely imperative in today's world.
- It is through information that companies grow and evolve, and is also a lack of it that some companies remain stopped in time.
- The use of information has meaning of power and its proper use is able to establish a competitive advantage.

**Who does not control, does not know.**

**Who does not know, does not manage.**

**Who does not manage, does not make improvements.**



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# PI System at Vale

Limit – Where do we use it?...

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# The PI System

It provides information about our operational plant...

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# Great equipment - Vale

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# The “Human Talent” is greater than this...

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# The PI System at DIFS – Southeast Ferrous Minerals Department

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# Structure of the PI System - Geographical vision

# Structure of the PI System – when it was introduced in SER2010

***350 licenses PI-Combo***



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# Structure of the PI System – 2011

***470 licenses PI-Combo***



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# New PI System – Application's view

# New PI System – Itabira's interfaces

# New PI System – Minas Centrais's interfaces

# New PI System – Mariana's interfaces

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## Benefits of the new structure

- **Quality assurance** and monitoring of online processes;
- Operational systems **integration;**
- Lower costs by **merging databases;**
- Systems management **centralization**;
- **Reliability, easy searching and democratization** of operational information
- License **control** improvement;
- **Standardization**;
- PI System **High Availability** (PI HA);



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## Benefits of the new structure

- **Utilization** of all the PI Server **capabilities** for:
  - Centralize the systems' development applications (PI ACE);
  - Create and analyze data from various sources (PI AF);
  - Create complex calculations, external to PI System. For example: real-time mass and energy balance; data reconciliation and cost calculations (PI ACE);
  - Generate alarms based on statistical calculations (PI SQC) ;
- PI System **alarms and notifications** (PI Notifications);
- **Availability of automation assets** (PI MCN Health Monitor).



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# Who sends data to our PI System?

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# Corporate world – Who receives the data?

**EBI Mining**

Moving mine

**SGDS**
Moving mine
Inputs and productions of iron ore plant
Results of  of iron ore quality

**SAP**

Moving mine
Inputs and productions of iron ore plant

**PGV**
Moving mine
Inputs and productions of iron ore plant
Equipment status

**MAXIMO**

Inputs and productions of iron ore plant
Equipment status

**GPV**

Inputs and productions of iron ore plant
Equipment status

# Key Indicators - Portal

# Key Indicators - Diretoria

Indicadores de Produção
Painel de Produção DIFS

Home "ontem"

| ITABIRA | 16/04 seg - 10:31 hs |
|---|---|

| Ontem | Hoje |
|---|---|
| 123,40 | 56,56 |

| Orçado | Programado | Ritmo |
|---|---|---|
| 122,09 | 59,20 | 127,71 |

+ detalhes

**Legenda**

CA Mina do Cauê
CE Mina de Conceição

DF Disponibilidade Física
UF Utilização Física
PR Produtividade
(*) em homologação

**Produção Diária por MINA "HOJE"**

Fonte: PI System

| | Produção | Orçado | Programado | Ritmo |
|---|---|---|---|---|
| CA | 28,74 | 57,44 | 42,88 | 65,63 |

+ detalhes

| | Orçado | Realizado |
|---|---|---|
| DF (*) | 97,96 | 97,96 |
| UF (*) | 91,00 | 91,00 |
| PR (*) | 2.684,61 | 2.651,93 |

+ detalhes

| | Produção | Orçado | Programado | Ritmo |
|---|---|---|---|---|
| CE | 27,83 | 64,65 | 16,32 | 62,08 |

+ detalhes

| | Orçado | Realizado |
|---|---|---|
| DF (*) | 100,00 | 100,00 |
| UF (*) | 92,83 | 97,11 |
| PR (*) | 2.902,02 | 2.165,64 |

+ detalhes

**Indicador de OEE (*)**

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# Moving mine - Report

Movimentação / Acompanhamento / ICD´s / Massa Desmontada / Perfuração / Relatórios

## Movimentação Total

**ÚLTIMA ATUALIZAÇÃO:** 15-abr-2012 23:59:59

| Frota | Hoje | Mês | Planejado | Orçado |
|---|---|---|---|---|
| 777 D / F | 117.917 | 2.299.771 | 2.036.677 | 2.091.732 |
| Scania | 15.677 | 394.533 | 320.000 | 428.518 |
| Terraplanagem | 5.400 | 42.672 | 25.000 | 0 |
| Ritmo - TOTAL | 138.994 | 2.736.976 | 2.381.677 | 2.520.250 |
| REM | 0,61 | 1,01 | 0,80 | 1,23 |

| Δ % Planejado |
|---|
| 18,71 |
| 28,19 |
| 92,29 |
| 20,75 |

| Saldo Mov. Plan. |
|---|
| 263.094 |
| 74.533 |
| 17.672 |
| 355.299 |

| Planejado por Turno |
|---|
| 26.463 |
| **Orçado por Turno** |
| 28.003 |

| Planejado Dia |
|---|
| 79.389 |
| **Orçado Dia** |
| 84.008 |

| Equipamento | Movimentação | DIA 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 777 D / F | Minério | 29.880 | 16.872 | 29.505 | 22.070 | 27.453 | 28.289 | 28.863 | 36.612 | 33.197 | 13.293 | 33.765 | 44.068 | 16.307 | 24.636 | 22.384 | 0 | 0 |
| | Hematita | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Estéril | 41.189 | 41.033 | 32.325 | 28.424 | 29.891 | 21.607 | 18.253 | 24.703 | 25.997 | 39.252 | 20.904 | 6.361 | 32.701 | 32.495 | 14.032 | 0 | 0 |
| | Produto | 90 | 2.424 | 2.069 | 7.409 | 89 | 3.133 | 5.558 | 1.263 | 2.535 | 8.692 | 1.969 | 3.952 | 8.729 | 1.539 | 0 | 0 | 0 |
| | OM | 17.469 | 19.545 | 11.129 | 11.361 | 13.038 | 14.257 | 17.601 | 10.339 | 12.434 | 10.123 | 10.488 | 16.348 | 12.719 | 14.880 | 9.027 | 0 | 0 |
| | Recorrência MA | 89 | 89 | 89 | 89 | 89 | 89 | 89 | 89 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total** | **88.717** | **79.963** | **75.117** | **69.353** | **70.560** | **67.375** | **70.364** | **73.006** | **74.163** | **71.360** | **67.126** | **70.729** | **70.456** | **73.550** | **45.443** | **0** | **0** |
| | Minério | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |



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# Availability of machines - Report

Automação > Extração e Tratamento de Minério > Mineração Itabira > Conceição > Operacao > Disponibilidade Maquinas Patio

## Disponibilidade de Máquinas de Pátio

### Diário

Hora inicial: t

Hora final: *

Aplicar

### Mensal

Hora inicial: 01

Hora final: *

Aplicar

### Anual

### Funcionamento (%)

| TagName | Time | Value |
|---|---|---|
| CE_EM3049_FUNC_DIA | 16/4/2012 11:10:00 | 81,73 |
| CE_EM6701_FUNC_DIA | 16/4/2012 11:10:00 | 100,00 |
| CE_EM6702_FUNC_DIA | 16/4/2012 11:10:00 | 100,00 |
| CE_RT6001_FUNC_DIA | 16/4/2012 11:10:00 | 94,58 |
| CE_RT6002_FUNC_DIA | 16/4/2012 11:10:00 | 50,91 |

### Funcionamento (%)

| TagName | Time | Value |
|---|---|---|
| CE_EM3049_FUNC_MES | 16/4/2012 11:10:00 | 82,76 |
| CE_EM6701_FUNC_MES | 16/4/2012 11:10:00 | 100,00 |
| CE_EM6702_FUNC_MES | 16/4/2012 11:10:00 | 97,23 |
| CE_RT6001_FUNC_MES | 16/4/2012 11:10:00 | 69,85 |
| CE_RT6002_FUNC_MES | 16/4/2012 11:10:00 | 54,05 |

### Funcionamen

| TagName |
|---|
| CE_EM3049_FUNC |
| CE_EM6701_FUNC |
| CE_EM6702_FUNC |
| CE_RT6001_FUNC |
| CE_RT6002_FUNC |

### Automático (%)

| TagName | Time | Value |
|---|---|---|
| CE_EM3049_FUNC_AUTO_DIA | 16/4/2012 11:10:00 | 72,59 |
| CE_EM6701_FUNC_AUTO_DIA | 16/4/2012 11:10:00 | 99,95 |
| CE_EM6702_FUNC_AUTO_DIA | 16/4/2012 11:10:00 | 99,95 |
| CE_RT6001_FUNC_AUTO_DIA | 16/4/2012 11:10:00 | 100,00 |
| CE_RT6002_FUNC_AUTO_DIA | 16/4/2012 11:10:00 | 100,00 |

### Automático (%)

| TagName | Time | Value |
|---|---|---|
| CE_EM3049_FUNC_AUTO_MES | 16/4/2012 11:10:00 | 69,26 |
| CE_EM6701_FUNC_AUTO_MES | 16/4/2012 11:10:00 | 99,94 |
| CE_EM6702_FUNC_AUTO_MES | 16/4/2012 11:10:00 | 97,11 |
| CE_RT6001_FUNC_AUTO_MES | 16/4/2012 11:10:00 | 99,66 |
| CE_RT6002_FUNC_AUTO_MES | 16/4/2012 11:10:00 | 99,97 |

### Automático (

| TagName |
|---|
| CE_EM3049_FUNC |
| CE_EM6701_FUNC |
| CE_EM6702_FUNC |
| CE_RT6001_FUNC |
| CE_RT6002_FUNC |



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# Monitoring of the Piracicaba River - Portal

## Rio Piracicaba

### Turbidez

### pH

### Oxigênio Dissolvido

### Condutividade

### Ponte Principal

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# Flowchart – PI ProcessBook

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# Flowchart – PI ProcessBook

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# Innovator case: Data of great equipment in the PI System

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# Map of Mines Complex Itabira

# Overview of Mine Complex Itabira

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# Excavators and trucks in Conceição mine

# Flowchart of the production process

# Flowchart of the production process

# Complex Itabira Automation

Treatment

The treatment plants are automated as ISA95, so the systems are integrated at all levels.

** Adapted the ANSI-ISA95 standard*

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# Automação Complexo Itabira

## Mine

- Assets not automated;
- Automation system without integration;
- Proprietary system not integrated (Dispatch and Equipment);
- Infrastructure with a low level of automation;

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# Complex Itabira

## Mine fleets

Mining plan

14 Drills

16 Excavators

81 Trucks

Treatment

## Infrastructure Mines

| | |
|---|---|
| Pumping Stations | 11 |
| Groundwater wells | 60 |
| Substations | 74 |
| Load Centers | 26 |
| Sprinkler system | 3 |

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## Integration of the IP Assets Mine – Pilot Project

- Integration of the Excavator 65 automation system to the Automation Technology Network;
- Configuration of PI OPC Interface in the mine;
- Standardization of tag names;
- PI System tag configuration;
- Internal Training;
- Applications utilizing PI ProcessBook and PI DataLink;
- KPI configuration for the existing mine equipment using the PI System.

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# Information of the Excavator in the PI System - Operator

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# Information of the Excavator in the PI System - Maintenance

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# Information of the Excavator in the PI System - Predictive

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# Information of the Excavator in the PI System – Pumps Maintenance

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# Information of the Excavator in the PI System - Alarms

| 1 | TAG | DESCRIÇÃO | VALOR ATUAL |
|---|---|---|---|
| 2 | IT_ESC65_PTO_SH_AALAR | Alarmes Ativos | SIM |
| 3 | | | |
| 88 | IT_ESC65_PTO_SH_APSH_01 | Alta Pressão X1-1 > 40 Bar - PM | NÃO |
| 89 | IT_ESC65_PTO_SH_APSH_02 | Alta Pressão X1-2 > 40 Bar - PM | NÃO |
| 90 | IT_ESC65_PTO_SH_APSH_03 | Alta Pressão X3 > 55 Bar - PM | NÃO |
| 91 | IT_ESC65_PTO_SH_APSH_04 | Alta Pressão X4 >70 Bar - PM | NÃO |
| 92 | IT_ESC65_PTO_SH_APSL | Baixa Pressão X2 < 30 Bar - PM | NÃO |
| 93 | IT_ESC65_PTO_SH_APSL_01 | Baixa Pressão X3 < 35 Bar - PM | NÃO |
| 94 | IT_ESC65_PTO_SH_APSL_02 | Baixa Pressão X4 < 50 Bar - PM | NÃO |
| 95 | IT_ESC65_PTO_SH_AREPQ_01 | Deslig. Repique Contator OK1-1 | NÃO |
| 96 | IT_ESC65_PTO_SH_AREPQ_02 | Deslig. Repique Contator OK1-2 | NÃO |
| 97 | IT_ESC65_PTO_SH_ARESP | Restrição Filtro Respiro TH (B25) - PM | NÃO |
| 98 | IT_ESC65_PTO_SH_ARFIL_01 | Restrição Filtro da Bomba de Controle 1 (B22-1) - PM | SIM |
| 99 | IT_ESC65_PTO_SH_ARFIL_02 | Restrição Filtro da Bomba de Controle 2 (B22-2) - PM | SIM |
| 100 | IT_ESC65_PTO_SH_ASLC_01 | Falha Sistema Lubrificação Caçamba | NÃO |
| 101 | IT_ESC65_PTO_SH_ASLC_02 | Sistema de Lub. Caçamba Desligado | NÃO |
| 102 | IT_ESC65_PTO_SH_ASUBC_01 | Deslig. Subcarga Motor do Radiador Superior | NÃO |
| 103 | IT_ESC65_PTO_SH_ASUBC_02 | Deslig. Subcarga Motor do Radiador Inferior | NÃO |
| 104 | IT_ESC65_PTO_SH_ASUBT | Deslig. Por Subtensão | NÃO |
| 105 | IT_ESC65_PTO_SH_ATERR | Falha a Tera 440Vac - PM | NÃO |
| 106 | IT_ESC65_PTO_SH_ATSH | Deslig. Alta Temperatura Trafo 440Vac | NÃO |
| 107 | IT_ESC65_PTO_SH_ATSH1_M1 | Deslig. Alta Temp. Enrolamento 1 Motor 1 | NÃO |
| 108 | IT_ESC65_PTO_SH_ATSH1_M2 | Deslig. Alta Temp. do Enrolamento 1 do Motor 2 | NÃO |
| 109 | IT_ESC65_PTO_SH_ATSH2_M1 | Deslig. Alta Temp. Enrolamento 2 Motor 1 | NÃO |
| 110 | IT_ESC65_PTO_SH_ATSH2_M2 | Deslig. Alta Temp. do Enrolamento 2 do Motor 2 | NÃO |
| 111 | IT_ESC65_PTO_SH_ATSH3_M1 | Deslig. Alta Temp. Enrolamento 3 Motor 1 | NÃO |
| 112 | IT_ESC65_PTO_SH_ATSH3_M2 | Deslig. Alta Temp. do Enrolamento 3 do Motor 2 | NÃO |
| 113 | IT_ESC65_PTO_SH_ATSH4_M1 | Deslig. Alta Temp. do Rolamento Frontal do Motor 1 | NÃO |
| 114 | IT_ESC65_PTO_SH_ATSH4_M2 | Deslig. Alta Temp. do Rolamento Frontal do Motor 2 | NÃO |
| 115 | IT_ESC65_PTO_SH_ATSH5_M1 | Deslig. Alta Temp. do Rolamento Traseiro do Motor 1 | NÃO |
| 116 | IT_ESC65_PTO_SH_ATSH5_M2 | Deslig. Alta Temp. do Rolamento Traseiro do Motor 2 | NÃO |
| 117 | IT_ESC65_PTO1_SH_ADESB | Deslig Desbalanceamento Corrente PTO1 | NÃO |

Alarmes ESC65 / Sheet2 / Sheet3

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## Integraton of Mine Assets in the PI System - Goals

- **Reducing** the MTTR value (mean time to repair) to Excavators 65;
- **Increase** the Movement KPI value (Greater availability and physics use);
- **Failure analysis** performed based on the history of the PI System;
- **Improvement of knowledge** of the asset in historical analysis and correlation of its variables;
- **Great** customer acceptance;
- **Training** for internal people;

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# Integraton of Mine Assets in the PI System - Goals

Increase of iron ore moving (ROM) with reducing of MTTR (mean time to repair) of Excavators 65

**Resultados de 2009**

| Equipamento | MTTR | DF | UF | HT | HM | Movimentação | Produtividade de 2009 ton/h |
|---|---|---|---|---|---|---|---|
| ESC65 | 6,00 | 64,37 | 75,48 | 4.253,61 | 3.118,81 | 11.626.242,99 | 2.733,27 |
| **Total geral** | **6,00** | **64,37** | **75,48** | **4.253,61** | **3.118,81** | **11.626.242,99** | **2.733,27** |

**Resultados após Implantação do Projeto**

| Equipamento | Novo MTTR | Nova HM | Nova HT | Nova DF | Nova UF | Nova Movimentação | Ganho em Movimentação Total | Ganho em Movimentação Minério | Ganho em Movimentação Estéril |
|---|---|---|---|---|---|---|---|---|---|
| ESC65 | 5,84 | 3.087 | 4.284 | 64,73 | 75,62 | 11.711.958,26 | 85.715,27 | 26.275,28 | 59.439,98 |
| **Total geral** | **5,84** | **3.087** | **4.284** | **64,73** | **75,62** | **11.711.958,26** | **85.715,27** | **26.275,28** | **59.439,98** |

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# Integration of Mine Assets in the PI System

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# Governance

## Applying IT management concepts in the Automation world

# Data Center

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# Thank you!

Álvaro Guedes
alvaro.guedes@vale.com

Luciane Moreira
luciane.moreira@vale.com

Luiz Henrique Duarte
luiz.henrique.duarte@vale.com

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