Establishing Fundamentals for Calculating Aluminum Factory's Product Final Price by Implementing Level3 Automation

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Abstract: This paper presents a sample Standard Level3 Automation implementation for improvement an Aluminum factory. Different approaches of an aluminum factory, the conditions of transferring information, the effect of these information on work cycle, the solution for decreasing the cost value, the importance of producing standard reports from manually and automatically collected data in a factory and finally the explanation of a realized sample implemented are the main approaches of this article. This kind of Total Information system will help the managers for the best usage of all potential, making new opportunity, improving situation, establishing operator controls, more exact prediction of future acts. Also the managing process will be improved by strict evaluating produces information. And by all these, analysis can act as a consultant for the managers.

Keywords: Level3 Automation; Information System; Product Lifecycle Management

Introduction

The Information of a total management information system, will help the leaders of an organization to for the best usage of all potential, making new opportunity, improving situation, establishing operator controls, more exact prediction of future acts. Also the managing process will be improved by strict evaluating produces information. And by all these, analysis can act as a consultant for the managers. On time and exact Information in correct form of produces of the complex must be reflected and this will create a well foundation for measurement calculating responsibility. The produced information is creating the end price system for estimating the sell price of the product, also control and decreasing the cost, Analysing the profitability of each one of the products and also making decision for development of the complex, and replacing the old machines with new ones.

Main Problem

In an aluminum smelting factory there are many different effective related points acting for the production line. And each one is effecting each other continuously. The information cycle between these points are as important than their lack of access through the level 2 automation data base will create a delay with the cause of producing a result of a examination or a measurement and also the obligatory of collecting the whole data in a centralized data base for an expert analyzing will make a decision for changing something in the production line. This delay in more cases will destroy the golden time and it's losing the agility of the organization.

In the best situation the these information are transferred between different points of the factory with a low level accuracy and in some cases because of the lack of a total analyzed solution system, the information will be archived and non usable.
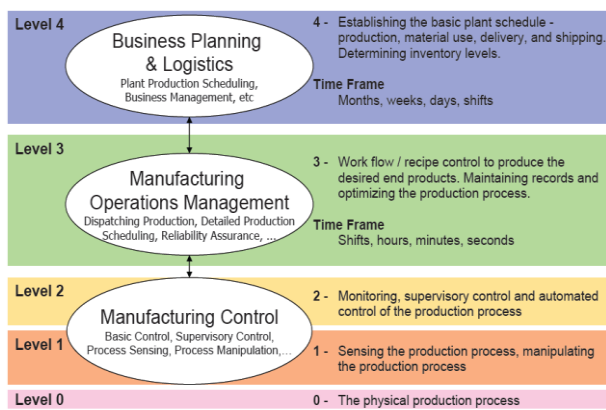
Level 3 Automation Method

In the 1.1 diagram we have the difference between each levels of industrial automation. As the diagram shown we have physical production process in level 0 that is main fundamental of every factory. In level 1 & 2 we have the manufacturing control it split's into sensing the production in level 1 and Monitoring supervisory control in level 2. In this case we are deciding in implementing level 3 as Manufacturing Operations Management for Dispatching production, Detailed production, scheduling, reliability, assurance by creating work flow and recipe control for maintaining records and optimizing the production process.

In this case we are surveying the Almahdi Aluminum company in Bandar Abbas city in Iran. There is a pilot for implementing level 3 automation which is successfully executed and become on load.

In this sample we are challenging with these items which are listed below:

- Allocation and control resources
- Managing production process
- Collecting and using data
- Quality management
- Process management
- Scheduling and follow up production
- Assessment the workflow
- Programming the operations and details
- Document control
- Human resources management
- Maintaining and maintenance management.

Implementing level 3 automation

Solution is given in two parts:

- Analysing and identifying level 3 system
- Implementing level 3 automation

In the first part we have these sections:

- Checking the existing data bank related to level 2 automation
- Analyzing the existing system in control process and laboratories and technical services and other parts related to the software
- Analyzing the requirements of all parts and designing the outputs and users list
- Designing inputs
- Designing events, workflows, processes, messages
- Implementing standard reports, which are matched with product processes.
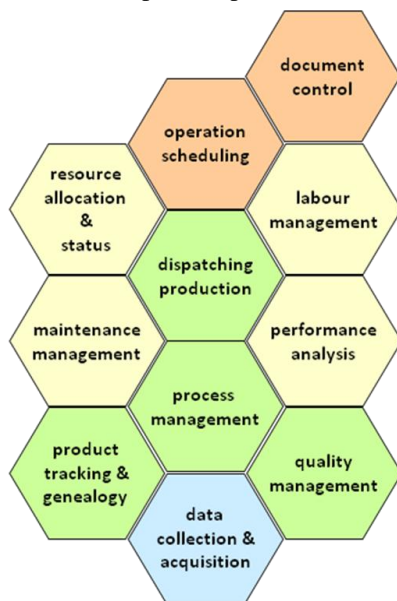
In the second part there are sections as below:

- Implementing the main data base
- Implementing the manual and automatic input interfaces

- Implementing the process engine for generating the second hand information for the managers.
- Implementing and setting up the communication protocol between different sections of level 3 program.
- Troubleshot, test and final setup of the program
- Presenting the final report and guides and handbook of the system.

Some benefits of this system:

- Automated collecting data from level 1 and level 2 data bases.
- Automated collecting data from sent samples to the laboratories.
- User friendly data entrance and data view from everywhere by all sections on the web.
- Implementing a centralized data base from all data that they are entered manually or automatically.
- Decreasing the human errors in data transferring and between different sections and input systems
- Generating information and standard reports from the main centralized data base.
- Large flexibility in generating reports and filtering data on the manager requirements.
- Defining user permission ability.

Solution

Our main problem is gathering information from scattered section in whole factory and centralizing them for generating on time, accurate reports for top and middle managers.

On the other hand some kind of data are generated in the factory and they are in special place of priority. Because of the limits of the level 1 data accessibility they are not transferred automatically and some of them will stored manually or maybe they will transferred in file format by human resources. This will make some troubles in the factory as below:

- Lack of accessing to strategic data from some sections to another one
- Probability of making mistakes in storing and transferring data by human resources.
- Lack of possibility for accessing laboratory and control data of the own section before pot's work

These troubles were improved by establishing the level 3 system.

Work stages

Architecture of the data base:

With a look at the technical details of the data credits, Level 3 main database is designed to in several given times in a day, stored data in the backup PLC servers will be transferred from the level 2 automation data base. We have a sample list in below.

عملیات	فعال	DCP	عمر دیگ	تاریخ شروع فعالیت	شماره دیگ	#
✏	1		7,305 روز	1370-04-23	1	1
✏	1		11,135 روز	1360-04-03	2	2
✏	1		15,327 روز	---	3	3
✏	1		15,327 روز	---	4	4
✏	1		15,327 روز	---	5	5
✏	1		15,327 روز	---	6	6
✏	1		15,327 روز	---	7	7

Table 1.

CastTest.fe	CastTest.si	CastTest.al	CastTest.time	CastTest.sample_id	#
0.08829	0.06188	99.83759	2011-07-18 08:32:22	07885	1
0.09253	0.06353	99.83250	2011-07-18 08:33:30	07886	2
0.09238	0.06449	99.83124	2011-07-18 08:34:38	07887	3
0.10168	0.06815	99.81892	2011-07-18 08:35:44	07888	4
0.39089	0.10284	99.48972	2011-07-18	07889	5

Table 2.

By implementing this step, control process information and the changes of the pots will be accessible from whole sections of the factory and the managers which has the permissions, while before this step just the automation section could have access from the own interface through these data. With this ability executive manager and programming experts can advice the system the way of improvement the product and on the other hand managers could program for their future market plans on their own look at the produced product.

On the next step by measurement height of melt on the pots and controlling the heat of the pot by experts of the section the technical details are entered automatically in the main data base and there is no action by human resources for this submissions.

These kind of data has the main role in producing quality and consumption of energy in the factory.

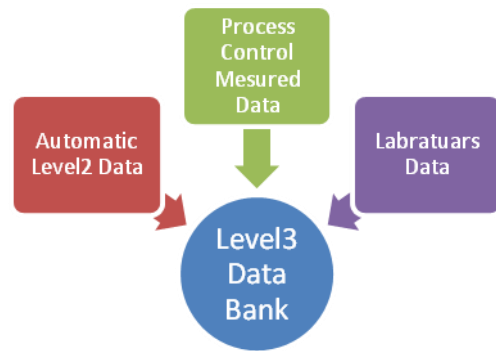In a general look this workflow diagram is established in the system:

Diagram 3.

By setting up this web based data base in My-SQL format each system users on their own permission level can generate their specified report from the main program.

It is clear for every person that accessibility of these kind of report is how important for improving the produce quality.

This data base has the ability of for increasing the level of production in these approaches:

- Expert and their workflow
- Supervisors and Middle managers
- Head managers
- Advisors and Planning analysts

Bellow with summarize, say how this important system work:

EXPERT LEVEL

In this level we can see Report with many details is useful, in fact an expert work with Details on company site so in this level Expert entering data and see Reports ONLINE that it appears in formats, listed below:

- 28 DAYs POT Report
  - Can customize for Range between 1Day to 1Year
- Monthly Report of pot
- Pot Amps efficiency Report
- bath temperature report
- Pot with over Heating bath temperature report
- Metal samples Report
- metal impurities changes diagram
- Changes of Concentration of additives in bath Diagram
- Additional Aluminum Florida Report
- Pot line Average Voltage Graph
- Pot line Average Amperage Graph
- Pots with a lining voltage higher than normal amount Report
- metal and electrolyte height Graph
- Anode effect frequency Graph
- average purity of the produced melt Graph
- Rate of metal Taping from pots
- Height of metal and cryolite graph
- Energy consumption per production of one

kilogram of aluminum graph
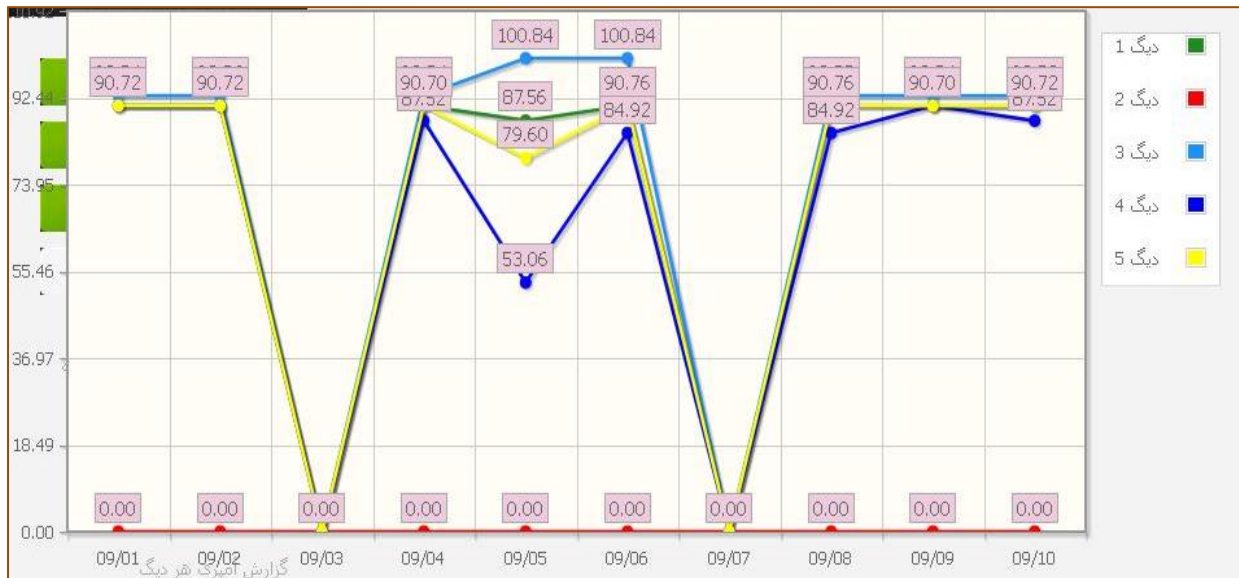
Report in level of Supervisors and Middle managers

After expert, this is Supervisors and Middle managers that need Summarized information to see how section under their control work, and guide expert under their control, with this aim this system produce this Report and form for Supervisors and Middle managers:

- Daily reports of Production poured ingot
- Daily production curve separating the percentage of grade
- Linier Graph of Percentage of grids in the month or the desired interval
- Management of all test results (correctly measured)
- Monthly report of raw material consumption coefficient
- Yearly report of raw material consumption coefficient
- Pot Voltage and temperature Graph
- Managing Daily reports of Smelting pot line
  - o Improved
  - o compare the accuracy
- each pot Report
  - o custom interval
  - o Total pot arbitrary choice
- Amps efficiency Report
  - o Comparing the performance of the plant section
  - o Comparing the performance of the plant shift
- Pot with Bath temperature higher than normal
- Metal samples Report

- metal impurities changes diagram
- Changes of Concentration of additives in bath Diagram
- Additional Aluminum Florida Report
- Pot line Average Voltage Graph
- Pot line Average Amperage Graph
- power outage time Report
- Pots with a lining voltage higher than normal amount Report
- average purity of the produced melt Graph
- Height of metal and cryolite graph
- monthly reports, charts the percentage of aluminum, silica and iron in the melt of pot line

Higher Managers Level

Higher managers, need General and Holistically view of their company alto they can view any Detail Report in system if they like, in this section Dashboard help us to provide this for this level of managers

Some example of this reports are:
- Daily Report of Factory
- production situation
- Product
- raw materials
- raw material orders
- monthly Report of Factory
- Yearly Report of Factory Compared with
- Prevision
- Last year
- Comparison chart of annual aluminum production

- Tables and graphs of aluminum compared with last month revived this month and same month last year
- monthly Comparative annual ingots production graph
    o in real
    o in Previsions
- Casting products line
- Purity aluminum Smelthing per month
- Diagram of the anode effect frequency and energy
- Amps and produce graphs of each pot efficiency
- A graph of energy per kilogram of aluminum produced

Conclusion

Before this changes, managers and supervisor has to gather manually their required data and in addition of the difficulties of this kind of data mining human errors are possible.

After implementing this database all the level1 and level2 data which were not accessible from other parts of the factory are in access for permitted persons of the complex in their own office.

On the other hand professional tools for generating several forms and reports will make the possibility for anybody who has the access from all over the world with just the condition of accessing through the internet to generate his own report of the status of the factory on the right time online.

Also gathering information of a long period time will give the ability for data mining for giving advices of consultats and managers in the right time and situation.

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