Do the Czech Production Plants Measure the Performance of Energy Processes?

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Abstract: *The research was focused to the actual situation in Performance Measurement of the energy processes in Czech production plants. The results are back – upped by the previous researches which were aimed to performance measurement methods usage in the whole organizational structure of the plants. Although the most of big industrial companies declared using of modern Performance Measurements methods, the previous researches shown that it is not purely true. The bigger differences were found in the energy area – energy processes. The authors compared the Energy concepts of European Union (EU) and Czech Republic (CZ) which are very different and do not create any possibilities for manager's clear decision in the process management strategy of energy processes in their companies. Next step included the Energy department's analysis. The significant part of energy processes in the production plants is still not mapped, described and summarized to one methodical manual for managing and performance measurement.*

Key words: Business Process Management, Energy Process Management, Performance Measurement, KPI´s

1. Introduction

There were a lot of possibilities of process management usage or its implementation to the industrial plants. Unfortunately, the energy area was not touched by the benefits of process management yet. It is true, that some production plants declared that the process management has been implemented, but after the deep research it was only the predication. The reality was other. Why is this area so interesting? Energy area of each of the production plants is key area for its operation and brings big costs with big saving opportunities. Management decision making is influencing by a lot of external and internal impacts, e.g. politics force which is applied during the energy legislative process.

Next impacts are variable prices in the market, business competition, etc. The internal impacts we could found in the production plan changes and the company growth. The initial situation was described in the research result chapter. It contains main reasons which lead the author to focus on the energy processes area. Main reasons came from the Energy concept of EU and CZ comparison which shown main differences in type of energy sources exploitation (the nuclear energy vs. the renewable energy sources such as wind power, solar power, water power and energy from the biomass), analysis of selected energy sources (prices and consumptions development) and from the questionnaire survey and case studies which was made in energy departments.

The article is aimed to energy process management level in Czech industrial plants.

1.1 The Business Process Management

Business Process Management (BPM) connects to reengineering of the business processes concept, which was formed by M. Hammer a J. Champy (2001). Since the time there have arisen a lot of BPM definitions.

Zuzák, Kříž and Krninská (2009) characterized the Process Management as the maximum effort of activities integration between separate operative units, which operate separately in the specific measurement.

Hromková and Tučková (2008) define the BPM as the methodology for measuring, analyzing and improving of core processes, based on Leeds and wishes of customers.

The BPM is the process by itself, which ensure continuing improvement of the company performance as wrote Burlton (2003).

For example Aalst, et al. (2003) defined BPM as supporting business processes using methods, techniques, and software to design, enact, control, and analyze operational processes involving humans, organizations, applications, documents and other sources of information. They argued that this definition restricts BPM to operational processes, i.e., processes at the strategic level or processes that cannot be made explicit are excluded. Note that systems supporting BPM need to be "process aware", i.e., without information about the operational processes at hand little support is possible.

Fingar and Smith (2002) divided BPM to the 4 development waves: the first wave was concentrated on constant improving of the processes and coincides in many ways with the philosophy of TQM, the second wave of BPM - consisted of a focus on BPR, or in short Reengineering, the third wave of BPM – refer to activities leading to the creation of a process focused organization and the fourth wave is a group of activities leading towards the achievement of competitiveness based mainly and exclusively on the processes.

So, we could define BPM as the complex of the procedures, methods and concepts which are used to processes effectiveness increasing in compliance with the company targets by using the appropriate metrics and measures, most called as KPI´s (Šmída, 2007).

How is the process management philosophy, methods and tools known and used in production plants? Tuček (2005) wrote that some theirs researches demonstrated that the exploitation of certain of the business process management components (e.g. the measurement of the effectiveness and performance of processes, the exploitation of process teams, etc.) was still very low in Czech industrial manufacturing production enterprises and that this even held true for large-scale enterprises (as regards their number of employees and turnover).

As author´s research shown, as well the energy processes are detached; even the company declared that it uses the process management in the whole company. The Process Modeling is recommended to use in BPM (because of the clear models creation, etc) (Tuček and Basl, 2011) as well as the IT systems usage (Tuček and Mikeska, 2011).

1.2 Energy Processes

For understanding energy processes we asked ourselves: "What is an energetic?" The energetic is the branch, which is aimed to development, forming, processing and transferring of energy.

Energy industries are the complex of supporting processes which ensure energy production operation, operation of administrative area, and next core processes. Novák (2011) wrote that energy process is the complex of activities its output is increasing of added value of energy materials which are going through it and ensuring of connected activities. The aim is to increase the added value for final customer. Energy processes goes through the whole company organization structure, whether it´s an inputs point of view (finance, material management, logistic) or outputs point of view (e.g. heat and light delivery for all of business units). Figure 1. shows sub process "Repair and Maintenance" made in ARIS software in detail.

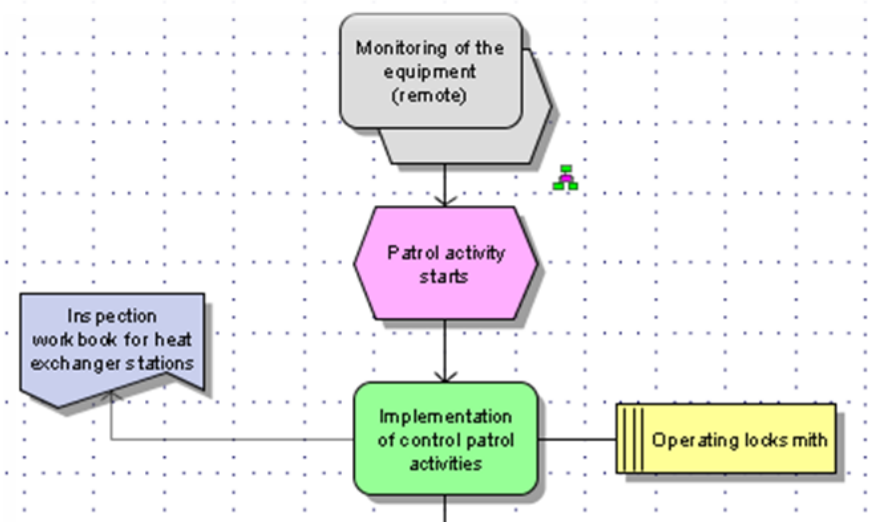

Fig. 1: Examle of process "Energy repair and Maintenance" in Aris SW
(Tučková, Novák and Hájková, 2012)

Why are energy processes so important? The answer should be found with help of Balanced Scorecard´s 4 perspectives (Kaplan and Norton, 2000):

- 1st perspective (financial): energy processes contain one of the important shares of company costs and its optimizing may result in high cost savings. Good approach showed Dickens and Gould (2010) with the idea of assigning of economic responsibility to managers to steer it as the corporate assets. Then they are under the top management pressure to make it more effectiveness.
- 2nd perspective (customer): the output is unique for customer and whatever variation has the big impact to the added value. The importance of energy processes rests in the machinery continuous operation on the part of customer, whose effort is directly depending on energy deliveries.
- 3rd perspective (innovation): new tendencies in renewable energy sources bring possibilities of process reengineering.
- 4th perspective (internal processes): as the energy processes are relatively easily measureable, it opens next reengineering possibilities. Because the energy processes run periodically it may be simply automated.

1.3 The Energy Management

Energy management is mostly defined with using of phrases such as energy efficiency, energy flow, energy medium conversion, consumption reducing, heat requirements, etc. Unfortunately, the processes are mentioned in accordance with energy flow only.

If we look to the energy management of buildings problem, the production area or any system, we can see that it is more or less complicated complex of energy and gas flow, its conversion, finances, etc. Our task is to manage this system with the aim of consumption reducing and energy usage (Lenža and Lenžová, 2007).

The energy management is the base tool in the energy treatment area (in view of environment aspects). Energy management applied in practice present the complex of tools and measures, which are used to managing and influencing of processes in energy system (Novák, 2011).

1.4 The Performance Measurement

Why measure performance? What Are Performance Measures?

When you can measure what you are speaking about and express it in numbers, you know something about it (Lord Kelvin, 1883). You cannot manage it what you cannot measure (Deming, 1993).

Performance measures quantitatively tell us something important about our products, services, and the processes that produce them. They are a tool to help us understand, manage, and improve what our organizations do. Performance measures let us know: how well we are doing, if we are meeting our goals, if our customers are satisfied, if our processes are in statistical control, if and where improvements are necessary (Department of Trade and Industry, 1995).

Neely, Gregory & Platts (1997) descript Business Performance Measurement System as “the set of metrics used to quantify both the efficiency and effectiveness of actions”.

The key characteristics of BPM system should be studied in the paper of Franco-Santos, et al. (1995).

How to proceed in measure performance? It shows the Figure 2 bellow.

Fig. 2: Performance Measurement process

(Department of Trade and Industry, 1995)

1.5 The Performance Measures

In case the plant is using some Performance Measurement System (PMS), it´s based on financial performance measures mainly. As Tangen (2001) stated: "To use a PMS that solely consists of financial performance measures can cause problem for company:

- financial measures are not directly related to manufacturing strategy;
- tradition criteria (such cost efficiency and utilization) may pressure managers for short-term results and, for that reason, discourage improvements;
- financial measure do not report accurately on the cost processes, products and customers;
- financial measures are not applicable to new management techniques;
- financial measures do not penalize overproduction.

Neely´s (1997) describing of the PMS brings the characters of measures. A PMS should:

- support strategic objectives (in energy area e.g. to deliver the energy sources in time to right production machinery, author´s remark);
- have an appropriate balance (covering all aspect, not only the financial), e.g. the energy repairs and maintenance flexibility);
- guard against sub-optimization (go against employee´s evaluation behavior effects);
- have a limited number of performance measures (more measures demands more analysis time);
- be easily accessible;
- consist of performance measures that have comprehensive specifications (e.g. collect the data, with what frequency, and how to act on the measure).

Performance measures should be by Neely (1997) and the other authors:

- transparent;
- simple to understand;
- have visual impact;
- focus on improvement rather than variance;
- visible to all;
- be derived from the strategy;
- provide timely and accurate feedback;
- relate to specific, stretching, but achievable goals (targets);
- be based on quantities that can be influenced, or controlled, by the user alone or the user in co-operation with others;
- be clearly defined;
- be part of a closed management loop;
- have an explicit purpose;
- be based on an explicitly defined formula and source of data;
- employ ratios rather than absolute numbers;
- use data which are automatically collected as part of a process whenever possible;
- provide fast feedback;
- provide information;
- be precise – be exact about what is beginning measured;
- be objective – not based on an opinion.

All the mention above is strictly valid in energy area, because of the measurable physical indicators and theirs big influence to final KPI´s.

In energy area there are a lot of metrics and measures defined in accordance to energy flow or to building heat cladding (Torcellini et al., 2005). But, it´s not defined for sub processes which ensure this

energy flow (e.g. Full Time Equivalent, etc.). In the energy area the non-financial measures are mostly useful (except energy consumption with a view to budgeting, etc.).

Some appropriate measures should be learned from the US Department of Energy (1995) – special defense project or from Czech Technical Standard (Czech Office for Standards, Metrology and Testing, 2010). But it is important to be aware in performance measurement to keep in mind all the external and internal consequences.

2. Process Approach to the Energy Processes Management and Theirs Valuation in Czech Production Plants

2.1 Research Methodology

The research results are listed in summary fashion for all of the researched Czech production plants, which were 59 at all (it was received 78 questionnaires but 19 incomplete). Parent population was 4.830 companies (base criteria: number of employees and production category). The selective group was 757 companies (criteria: energy departments inside the company and energy management availability). Questions were selected as semi-closed to be able to answer respondents own opinion by Gill and Johnson (1991) methodology. Questionnaires return was 8.7%. It may seem not much, but Eschenbach (2004) presents the return from 7% to 47% in controlling researches which are near to energy area specification. These researches were much more general. Next data source was the case studies made in 12 big industrial plants. Case studies included direct interview to energy managers. Finally, 5 of them agreed with publishing of the results.

2.2 Research Results

A. Energy concepts, price and consumption analysis

At first the EU and CZ energy concepts were analyzed. Key indicators of EU energy policy contain Agreement between member states and the secondary policy which is concerned to competition and state support. The Policy is promoted with help of the Regulations. One of the primary targets of the EU energy strategy is creating of market conditions for electric and natural gas. This is followed by the Czech Republic too. But if we look to energy concepts EU and Czech Republic we can find fundamental differences in the future usage of energy sources. While EU is oriented to renewable energy sourcing usage, Czech Republic is oriented to nuclear energy source. This is first impact which effect on energy managers thinking.

Next impact are the energy sources prices and theirs consumption. Based on the case studies results, companies, due to cost savings, very often risk during energy sources purchasing by the gradual purchase. But, for example if prices growth in the long term (and company didn´t fix a contract with the fix prices) it could lose.

Why the Czech companies do it? Simply, because the prices in the Czech Republic growth rapidly (Fig. 3).

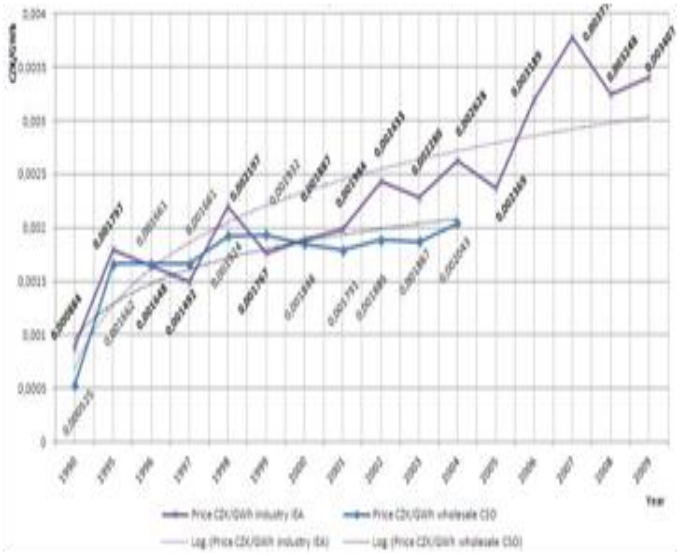

Fig. 3: Development of electro average prices in Czech energy market
(Czech Statistical Office, 2011; International Energy Agency, 2011)

Consequently the consumptions and prices development were compared with results showed in Fig. 4. The analysis returned more or less linear growth of both indicators.

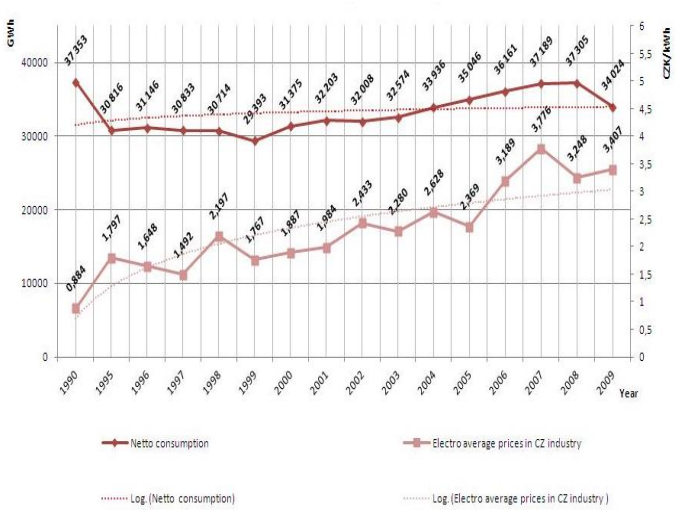

Fig. 4: Development of electro average prices and consumptions in Czech energy market
(Czech Statistical Office, 2011; International Energy Agency, 2011)

The heat energy analysis showed the similar situation, but there we can see the impact of the production plants to take an action to reduce the consumption by the heat cladding.

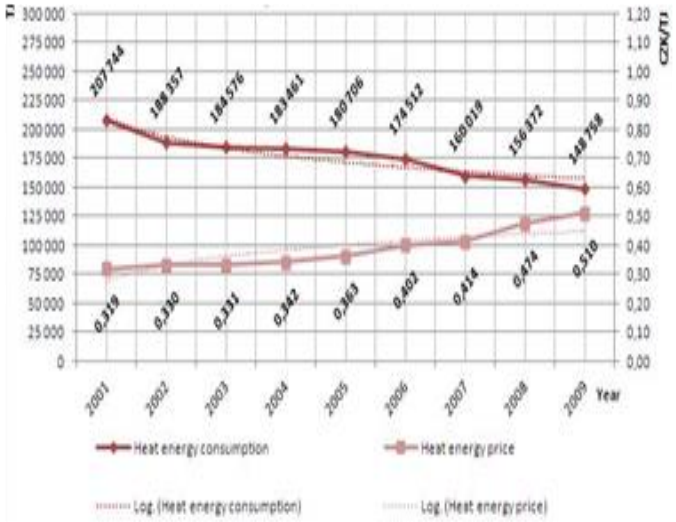

Fig. 5: Development of electro average prices and consumptions in Czech energy market
(Czech Statistical Office, 2011; International Energy Agency, 2011)

It could be expected next growth of energy sources for long time (Energy Regulation Office, 2012). Based on the analysis mentioned above, there were set up main impacts to energy management decision making. It was helpful for questionnaire creation.

- 1st EU and Czech energy concepts differences have a big impact to company energy planning in strategic level to hold the competition advantages.
- 2nd The analysis of the energy sources prices and its consumption showed the growth. This evokes requirement of manager's approach to change energy processes managing. The automation and simulation of virtual plants 3D models should be used.
- 3rd The analysis of heat energy showed requirement of additional investments to heat cladding of the buildings and machinery complement with regulation technology.

B. Process approach in energy area of CZ production plants

The research results which came from the questionnaire answers demonstrated that even if companies declared the process management implemented, they do not use its benefits in energy area.

The research presented by Šiška (2008) in the Performance Measurement usage in the domestic (Czech) plants shown that more than 75% of companies is using the oldest managerial accounting form or the controlling (73,9%) for performance measurement. All the respondents were asked to choose from 10 methods including ABC, Balanced Scorecard, MVA, TQM, TOC, Lean management, and others. No modern methods were known or implemented.

As was mentioned by Skinner (1974): "…the general tendency in many companies is to evaluate manufacturing primarily on the basis of costs and efficiency…."

There were founded that 59% of companies' do not use the Business Process Management and Performance Measurement concepts of energy processes. Main reason to think about using assets of BPM was introduced: delivered on account of prices increasing (80%), ISO certification (60%), competitors benchmarking necessity (70%) and company reorganization (15%).

41% as the rest of companies which do not use the Process Management declared that they are thinking about implementation of concepts such as Balanced Scorecard, Six Sigma, EFQM or Benchmarking. But the case studies have shown that the number of companies which do not use anything is higher (67%).

C. The case study in the energy department of the tires production plant

The presented company was the biggest one in the research case study process regarding the area, turnover and the number of employees. The plant was operating in the chemical industry area, especially tires producing branch of activity.

The type of the production was relegated to the mass production and the lot manufacture (flow production). This limited company plant was at the case study process owned by Multinational Corporation.

As was mentioned above, the research object was the biggest one from the industrial plants pool.

The part of the production is oriented to foundry industry, respectively the mould casts.

Its main customer was identified from the automotive industry, the wholesale warehouses as well as the outlets, car service garages and last but not least the national and private transport companies.

The author discussed with head of the energy department as well as with employees of each of the sub-departments during the case study process. The plant was not audited by approved energy audit company and was not certified in the energy management area based on ISO 5001:2011.

The department was organized in view of the energy sources flow, it means to Heat Department (hot steam), Water and Air Department (water, pressured air and nitrogen) and Electro Department (electrical energy). Manager of the department said: ”Our organization is based on the process organization rules, but follows the energy sources flow too. So, partly it is combination of both. The structure of the organization is trimming with a view to cost saving needs.” This not follows the process approach and it is inhibiting to manage processes.

The last one the Maintenance and Repairs Department was analyzed. This department was charge of the machinery repairs and maintenance in individual energy departments. The employee’s pool was strictly scaled 50% fix to 50% variable because of the headcount (HC) saving in budgeting process. This did not allowed making HC savings by the parent company and “went” across the right costs allocation and cost savings calculation.

The Repair and Maintenance Department employees made their job for the most part separately for the other individual departments, so they could be allocated directly to these departments.

On the contrary, the specialists were relegated to the individual departments and were managed by the chief of these individual departments not by the main department manager.

Theirs activities were blended across the whole structure of the department. The specialists are not multi-professional. They had not necessary competences. There raise upped the communication barriers.

Manager of the main department declared that the communication and competencies manual is issued. But this document described only competencies to the individual machinery not to the processes. The process responsibility was not set-upped.

There were rendered other activities concerning checks, revisions, measuring and regulation, posting, transport ordering, purchasing, training and certification in the main energy department.

Some of these activities were doubled (e.g. the parallel physical and electronic reading of consumptions, reporting and more than one SW system with the same functionality).

It was found a lot of inadequacies which could be eliminated:

- The process approach is missing in Energy Department even if the company declared that is using process management. The Performance measurement methods nor the Key Performance Indicators are not applied and used.
- The organizational structure is inappropriate to process management rules. By the departments restructuring and with help of employee’s multi-professional increasing the overall headcount should be decreased, so the cost should be decreased too (the consolidation of two specialists to one can be realized, and replacing of maintenance men (the consolidation of Heat Dept. specialist with Water and Air Dept. specialist to one position). The second alternative was to outsource the Maintenance and Repair Department. But with a view of know-how protection and production run.
- There was not set-upped the responsibility of the each process and some activities was doubled.
- The non conceptual employee´s integration to the fix and the variable group didn´t allowed cost savings.

- During the discussions there were explained the benefits of the process analysis and organization structure change to the process one.
- The manager argued that the actual situation was based on historical needs and that it is measured by the freedom from disturbances and by the minimum of energy black-outs.
- But as was found, the right reason is on-coming generation exchange of the employees. The long-standing staffs of the Energy Department presented the resistance to any process's changes because they were worry about to disclose the real situation not to be reduced themselves. There were doing checks without any round plan, so some machinery, distribution points and the other were double checked or wasn´t checked at all.
- Next analyzed area was the prices of energy sources. The plant reacted to growing prices of deliveries with the penetrative dealing to the suppliers with request of price reductions and the planned corridors of the send out chart. Next "weapon" in their hands was the argument of changing the supplier's possibility.
- There were discussed next possibilities of price reductions such as new technologies investments (e.g. new compressor of lower input), deliveries process change (investment to steam distribution pipeline reduction – the volume losses) and sub processes reduction (the administrative – accounting, training, etc.).
- With a view to process description missing was very hard to do these changes.
- The Energy Department Manager was not informed periodically about the energy costs share of the overall plant costs (production costs).
- This fact not allowed to do or to manage activities more effectively (set-up processes right to save costs).
- Next problem (with which the author had met in a lot of companies during the discussions about the process management implementation) is that the staffs are worry about more work which (they think) will come from the process management. They presented that nobody is reading the manuals or the process maps and employees use the historical know-how. So they were not interested in the PM benefits (acceleration of activities, quick training new employees, higher effectiveness, etc).
- Main recipient of information which comes from energy systems is own energy department in the first phase for final customer´s reporting (CEO, CFO, parent company).
- The parent company´s purchase division was providing benchmarking between all the plants. According to energy manager statement this benchmarking is not true because of the different production of each of the plants (the energy intensity). The process benchmarking was not done.
- The energy consumption, repair and maintenance, and the investments planning processes were elaborated strictly regarding to the production plans.
- The company was presented the process management as established mainly in the production area, so it´s mean that the main processes were described and the maps existed in place. But the support processes were not took in mind.
- The energy processes, as was mentioned above, were not described, mapped and included to internal documentation (no handbook, manual or procedure).
- The process word-book was missing, so the communication problems occurred.
- The case study has shown that the Energy Department is using only KPI´s based on the energy flow. Other KPI´s were not set-upped. This constrained to start re-engineering of the processes and to set up the process responsibility of each employee with a view to motivation possibility.
- The industrial plant didn´t use any methods or concept or theirs combination included in Performance Management.
- It was argued that the unambiguous method does not exist. All the requests were subordinated to the production area.

- The next findings came from the case study:
- The energy strategy was not systematic; it was targeted only to individual production subsystems.
- The plant used only limited possibilities for energy prices grow.
- The employee resistance prohibited the effectiveness increasing, it follows:
- The employee motivation was not based on the real working output.
- The effort of using methods and concepts for performance measurement didn´t exist.
- The case study was discussed to the top management and based on the approval the Energy process analysis was started.

D. Performance Measurement methods and concepts in production plants

Tuček and Zámečník (2007) asked respondents in his research, which concepts (included to Performance Measurement System) are used the industrial plants. Respondents introduced Activity Based Costing (ABC), Balanced Scorecard (BSC), Benchmarking, and European Foundation for Quality Management (EFQM), Performance Pyramid, Six Sigma and Value Based Management (VBM) concepts.

This research used these concepts as the base to find if the industrial plants use it in energy area too (as mentioned above). The research showed for the energy departments in industrial plants there doesn´t exist any universal method or concept. As was found in the research, companies use complex of the concepts, or their own method which come from the best concepts benefits, but not in the energy area. 24% of industrial plants do not use any concept or its combination included in Performance Measurement system in the company. 76% of plants use concepts mentioned in Tab. 1.

Tab. 1: Concepts rank - CZ plants *(authors)*

No.	Concept	Share
1	Benchmarking	48%
2	BSC (Balanced Scorecard)	35%
3	ABC (Activity Base Costing)	24%
4	6δ (Six Sigma)	22%
5	EFQM (European Foundation for Quality Management)	13%
6	VBM (Value Based Management)	9%
7	DEA (Data Envelope Analysis)	7%

The research results shown that the first three most preferred (not used) concepts (for whole company as well in energy area) are Benchmarking, Balanced Scorecard and Activity Based Costing.

KPI used in energy departments in production plants cover only the general energy flow and doesn´t reflect other processes which ensure this flow. In addition 50% of production plants do not deal with performance measurement incl. KPI´s.

As was expected, companies use mostly KPI´s aimed to energy flow evaluation (costs and time 100%, physical measures 63%).

3. Conclusion

Within the literary research was found that not many authors deal with energy processes with a view to ensuring of energy flow in the production plants. Much more described problem is the energy flow processes in general as the main process. We can find physical measures and methods to increase energy efficiency and reduce the energy costs. Unfortunately, it is not sufficient. The questionnaire research and case studies demonstrated missing of energy process maps, describing and existing of complex measures which include energy sub processes. The process approach is missing even if

implementation of the BPM is mentioned. KPI´s which are used in the Performance Measurement system are not stated. The measures are set for alone energy medium flow only.

Actually, most of the Czech production plants are not prepared for flexible reaction to EU and CZ energy concepts changes and differences with a view to energy flow ensuring.

Main benefits which could be useful for industrial plants are flexible managing of the energy departments, headcount decreasing, duplicate activities reducing, effective training of new staffs and of course the costs saving.

The Energy Processes Management implemented clearly up to the processes in the lowest level can return increasing of the production plants and last but not least added value to the customer.

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