Sustainable Management and Business Excellence in Dravske Elektrarne Maribor

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Abstract: Hydropower is a major renewable energy resource that can play an increasingly important role in enabling communities around the world to meet sustainability objectives. The International Hydropower Association has produced Sustainability Guidelines to promote greater consideration of environmental, social and economic aspects in the sustainability assessment of new hydro projects.The role and significance of sustainable management, as a part of business excellence, becoming ever more important in the future. The increasingly limited environment resources demand managers of organisational systems to perform alternative measures in managing organisational systems. On e of the techniques being developed for this purpose is Business Excellence Model. The article focuses on Sustainable Management as a part of Business Excellence of Dravske Elektrarne Maribor (DEM).

Key words: business excellence, environment, hydropower, management, sustainable management,

1 Introduction

The future landscape of European energy supply and demand will have to make much greater use of new renewable energy sources and focus more upon energy-efficient methods. Today, we can be proud of the fact that Europe is already a leading advocate in the fight to halt the depletion of natural resources and prevent climate change. It is in the context of the EU commitment to change the landscape of energy that the Sustainable Energy Europe 2005-2008 Campaign has been launched. Set for a period of 4 years, the Campaign will contribute to the achievement of EU energy policy goals and targets in the fields of renewable energy sources, energy efficiency, clean transport and alternative fuels. The specific objectives of the Sustainable Energy Europe 2005-2008 Campaign are to:

- Raise the awareness of decision-makers at local, regional, national and European level
- Spread best-practice
- Ensure a strong level of public awareness, understanding and support
- Stimulate the necessary trends towards an increase in private investment in sustainable energy technologies [1]

According to this, producing as much as possible is no more a central issue that should affect or change the economic course of development or improve quality o life [10]. Sustainable management with innovation is of vital importance not only for those who want to increase or sustain economic growth in a given area (region, state and the like) but also for those who benefit(in) directly. According to this, producing as much as possible is no more a central issue that should affect or change the economic course of development or improve quality o life [10]. The role and significance of sustainable management, as a part of business excellence, becoming ever more important in the future. It is about a new approach in managing the organisation and environment resource planning in society. Integrated production processes innovation model which promotes production processes innovation was derived from the model of managing company policy following the interest theory and

business excellence [6]. It was conceived in the frame and interdependence of both objective and subjective starting points of initial change agents as well as from process knowledge of process managers. The successful development and implementation of processes innovation in an organizational system can produce a significant saving in the amount of business and environment resources and therefore a smaller environmental impact. The natural environment is a limited production factor and not, as had previously been considered, only the supplier of raw materials. These have previously been free goods without an assigned market value, while the environment has been an agent for the neutralisation of wastes and emissions of production and consumption [3]. Generation facilities are the key element in every electricity supply system as they ensure sufficient quantity of electricity and a balance between produced and consumed power in the system. In particular, this is true for hydroelectric power stations, which are an indispensable renewable source of electrical power in every electricity supply system. The production of electricity in an electricity supply system influences the price of electricity and furthermore the costs of functioning of the whole system [16].

The reliability and stability of supply of electrical power to the consumers is one of the main factors of quality of electrical power in the system. The generation facilities play an important role, because they have to produce enough of electrical power. That means that the maintenance work at generation facilities has to be planned and performed so that enough electrical power is produced in the system. Only in that way we can achieve a high rate of electrical feed-troughs, independently of maintenance work in specific units in the system.

2 Problem Formulation

2.1 Business Excellence and Quality Policy of DEM

One of the most important thing in business excellence is leadership. Leaders establish utility of purpose and direction of the organisation. They should create and maintain the internal environment in which people can become fully involved in achieving the organization's objectives [11]. Figure 1 presents Leadership with PDCA approach.

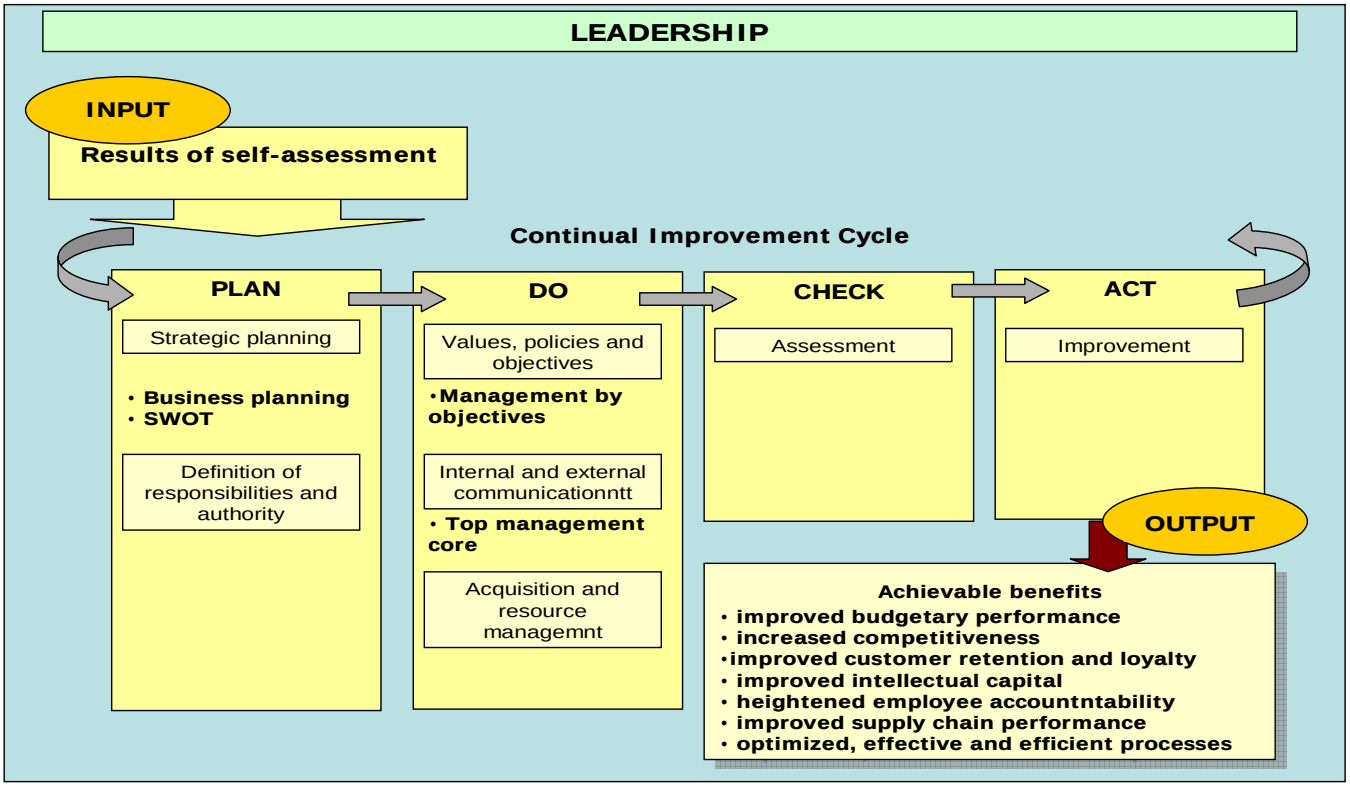

Figure 1: Leadership [11]

For an organisation to maximise the benefits of adopting the Business Excellence Model, a management team must first ensure that it is comfortable with these concepts. Clearly if these Concepts are not fully understood and accepted then progress with adopting the Model will be difficult and potentially meaningless. There is no significance intended in the order of the concepts. The list is not meant to be exhaustive and they will change as excellent organisations develop and improve. The Fundamental Concepts are:

- **Results Orientation;** Excellence is achieving results that delight all the organisation's stakeholders.
- **Customer Focus;** Excellence is creating sustainable customer value.
- **Leadership and Constancy of Purpose**; Excellence is visionary and inspirational leadership, coupled with constancy of purpose.
- **Management by Processes and Facts**; Excellence is managing the organisation through a set of interdependent and interrelated systems, processes and facts.
- **People Development and Involvement**; Excellence is maximising the contribution of employees through their development and involvement. Figure 2 presents Involvement of People with PDCA approach.

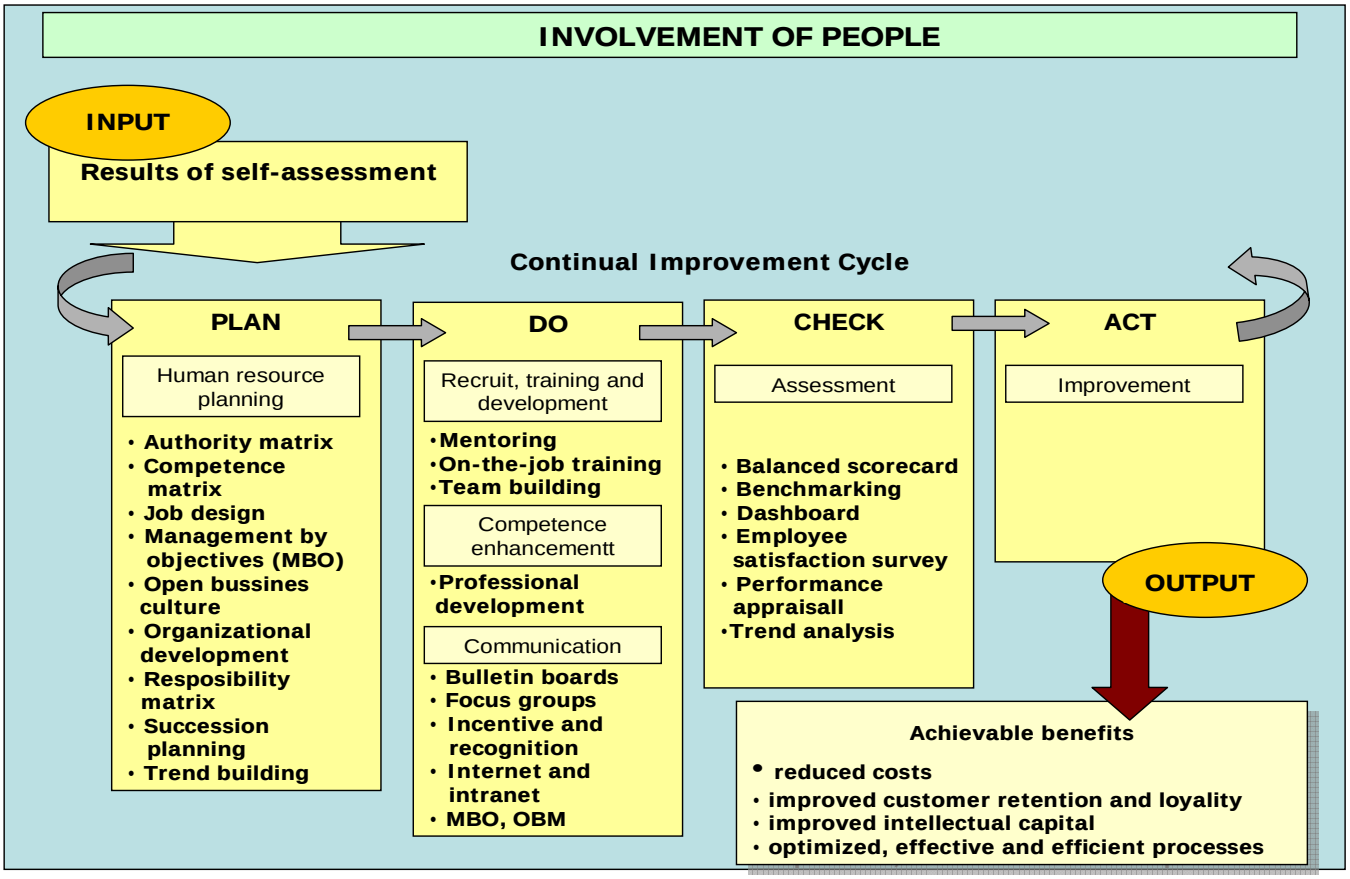

Figure 2: Involvement of people [11]

- **Continuous Learning, Innovation and Improvement**; Excellence is challenging the status quo and effecting change by utilising learning to create innovation and improvement opportunities.
- **Partnership Development**; Excellence is developing and maintaining value-adding partnerships.
- **Corporate Social Responsibility**; Excellence is exceeding the minimum regulatory

framework in which the organisation operates and to strive to understand and respond to the expectations of their stakeholders in society [13]. Figure 3 presents Business Excellence Model.

Figure 3: Business Excellence Model [12].

The inclusion of enterprises in the international market, the care for reputation, that the enterprise profit with the environment protection and permanent development, places the politics of environment protection and business excellence to the base of the professional politics [7]. The current position of an organization with regard to the environment can be established by means of an initial processes operations and quality policy[3]. This is why the integration of environmental goals into the system of enterpreneurial policy is so vital. In theory, we can distinguish the ones, which pertain to the inflow (rational use of raw materials, materials, energy, etc.), and those, that relate to the outflow (absolute limitation of waste and emissions), with the simultaneous maximisation of waste re-use [8]. All the activities of Dravske Elektrarne Maribor comply with quality management standards according to the ISO 9001:2000, ISO 14001:2004 and OHSAS 18001:1999 certificates.All the processes within the company are carried out so as to ensure the quality of all the company's major activities, including the generation of electric energy in hydroelectric power plants, the maintenance of energy facilities and equipment, the development and management of investment projects and the operations of the company as a whole. A comprehensive system combines the assurance of quality with the responsible treatment of the environment while also ensuring safety at work and the health of employees. The quality system implementation in all areas is defined by the specific rules of governance and the meeting of principles and guidelines is proven by the appropriate systems documentation. At the Dravske Elektrarne Maribor company, all processes undergo continuous surveillance[12]. Achieving excellence is the fundamental guideline for the actions of the company and those of each individual in it.
A significant part of the quality management system is the responsible treatment of the environment. Technological solutions are established and supervised so as to decrease their effects on the environment. All actions affecting the environment are carefully planned

and implemented in accordance with the principles of the sustainable use of natural resources. The responsible treatment of the environment includes a planned encouragement of knowledge, awareness and actions which will allow for the preservation of nature as well as our technical and cultural heritage. The quality of operations and the efficiency and success of company depend on the knowledge and capabilities of employees. The management system directed at maintaining the health and safety of employees is based on the management of the risks associated with the company's operations [12].

2.2 Sustainability Guidelines

The International Hydropower Association has produced Sustainability Guidelines to promote greater consideration of environmental, social and economic aspects in the sustainability assessment of new hydro projects and the management and operation of existing power schemes. Thorough sustainability assessments should ensure that detrimental social and environmental impacts are avoided, mitigated or compensated and positive outcomes are maximised Of necessity, the principles are genereic since each particular power scheme and development project will have its own unique set circumstances influenced by scale, geographic location, social, legal and political constructs. The guidelines will[need to be adapted to the specific context of each particular project. The principles outlined span the following six elements:

- IHA policy
- The role of governments
- Decision making processes
- Hydropower – environmental aspects of sustainability
- Hydropower – social aspects of sustainability
- Hydropower – economic aspects of sustainability [14].

3 Problem Solution

3.1 Care for Sustainable Development

The appropriately designed and planned use of the capacities of Dravske elektrarne Maribor during average annual flows allows an annual generation of 2656 million kWh of electric power. The largest quantity generated by the Drava power plants is 1241 million kWh in the summer period, 822 million kWh during transition periods and 539 million kWh during the winter. More than 40 % of generation is ensured by Zlatoličje HPP (21.7 %) and Formin HPP (20.6 %). The importance of the Drava power plants is amplified by their ability to guarantee reserve power in case of breakdowns in the electric power system of Slovenia. By filling the reservoirs during the night and emptying them during the daytime, the Drava power plants can move a portion of their daily generation from periods of smaller demand to periods of higher demand at least eight months of the year. Operation utilising flow accumulation also allows for the participation of power plants in the secondary frequency and power regulation of up to 45 MW. The capacity of the upper Drava power plants due to implemented sequential refurbishment of Dravograd HPP, Vuzenica HPP, Vuhred HPP, Ožbalt HPP, Fala HPP and Mariborski otok HPP concluded in 2005 was increased by 67.3 MW with generation higher by almost a tenth.The total net capacity of the Drava power plants in Slovenia is 577 MW while the total generation of the plants represents around 25 % of the electric power generated in Slovenia [15].
Where the water roars and where it ceases, sources of life can be found. The damming of water on the Drava River, the biggest river in Slovenia in terms of its energy potential, allows for the use of captured power.
Figure 4 presents average share of individual power plant in the total generation.

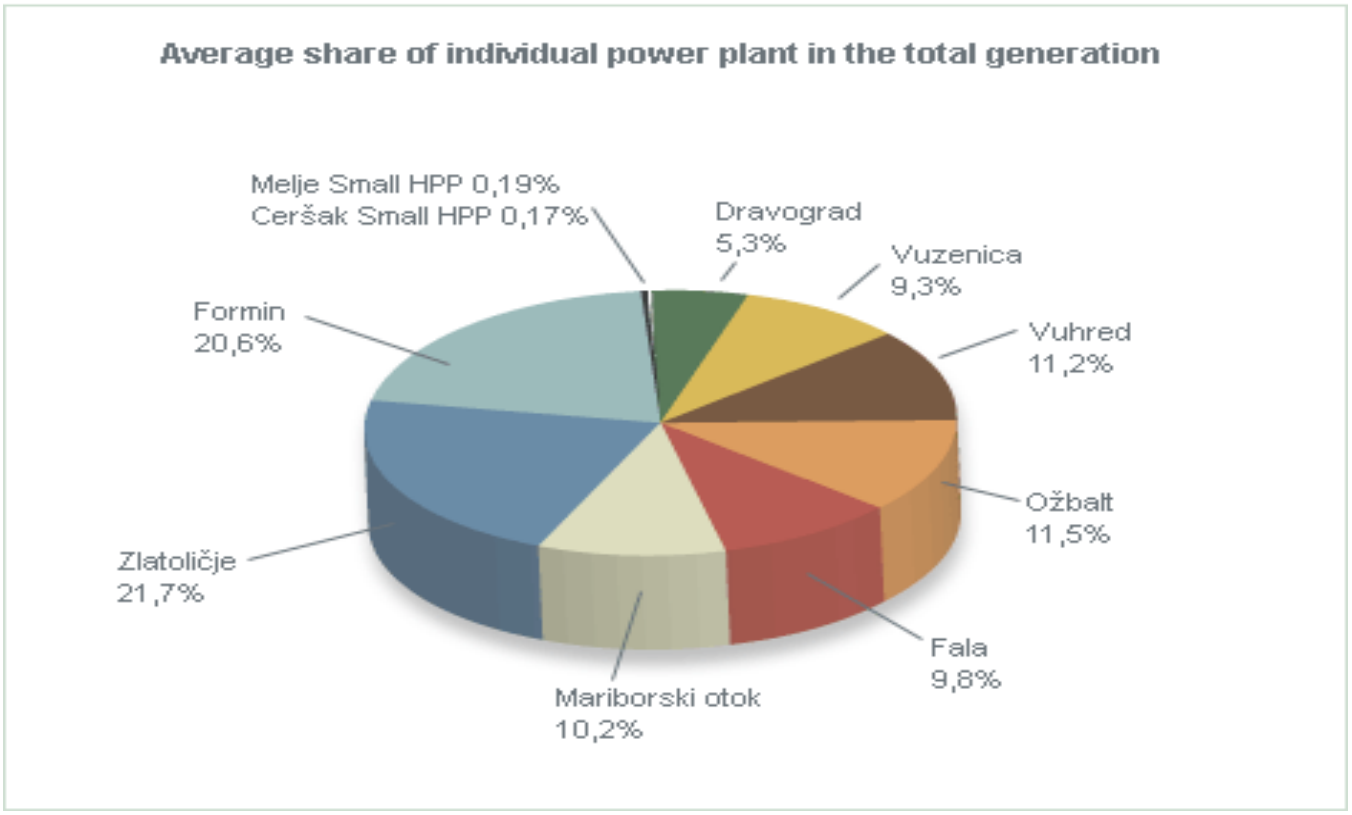

Figure 4: Average share of individual power plant in the total generation

Total net capacity of DEM present figure 5.

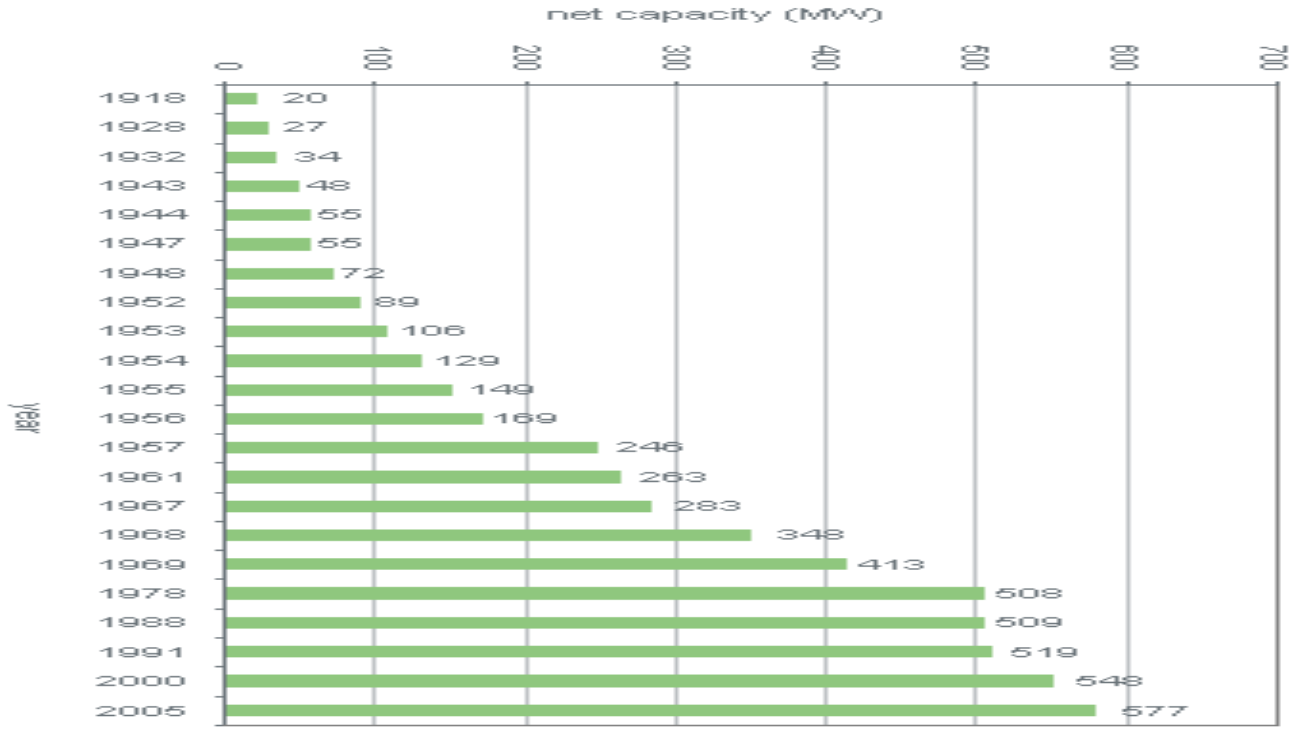

Figure5: Total net capacity of DEM

The newly created nesting islands for water birds and the developed embankments of the river and its lakes return back to the entire area its natural diversity of life. The generation of electric power, which in the past influenced and changed the life of the river, today represents a watercourse of natural coexistence. Renewable resources of energy will, through the well-deliberated management of the environment, remain available for many generations to come [12]. Figure 4 presents Maribor Lake.

Figure 4: Maribor Lake [12].

Our care for sustainable development safeguards the quality of life for current and future generations. For it is only right that we are close to nature, which allows the existence of both ourselves and the people with whom we live together. We want to responsibly and creatively co-shape the environment in which we operate, and thus our attention is directed towards numerous projects in all areas of Dravske elektrarne Maribor's activities, from Dravograd to Formin. Within the scope of economic possibilities, we support a number of humanitarian, sports, cultural, educational and other projects, as well as socially advantageous activities on the local, regional and national level [12].

3.2Reliability

Reliability in general has become very important in a number of industry sectors especially due to its practical usability in connection with the optimization of production, operation and maintenance of systems or their components [18].

The electric power supply system is consisting of three technologically interconnected sections – production, transmission and distribution. They have several layers of mutual links and interdependence. Due to its redundancy, the production system has no deterministic values as regards its influence on the reliability of power supply to consumers. To ascertain the reliability of power supply, two probabilistic indices are used:

- LOLE - loss of load expectation and
- LOLP - loss of load probability,

expressed in the annual number of hours. They depend on the structure and availability of generation units in system.

The continuity of supply has to do also with reliability. According to definition, reliability is the probability that the device, assembly or system will be able to function under certain condition and in the selected time interval [17].

Assessment of reliability is based on the monitoring of reliability indices that can be calculated according to the probabilistic or deterministic methods. The probabilistic methods are used in assessing reliability in development plans. The requirement for more precise reliability assessment call for the use of deterministic methods, which is defining reliability indices on the basis of actual data on events.

In the research carried out so far [17] extensive calculations of the reliability indicators based on data about actual functioning of electric power distribution systems were prepared.

For this purpose, two basic system indicators covering the number and duration of outages were applied.

- SAIFI - system average interruption frequency index and
- SAIDI - system average interruption duration index.

Recently, the rule of nines [17] is used to measure the suitability of availability of power supply to consumers, rendering the value of availability in percentages – Table 1. The annual duration of outages is depending on different levels of availability. The annual availability expressed with one nine defines the annual duration of outage of 36.5 days and is somehow typical of developing countries.

In the Slovenian electric power distribution system, conditions in this field are slightly lower than three nines; the long-term aim is so achieve the availability of four nines, which is the case already in some European countries.

Table 1: Duration of outages for availability expresses with number of nines

Availability (%)	Number of nines	Annual duration of outages
90	1	36.5 days
99	2	3.7 days
99.9	3	8.8 h
99.99	4	52.6 min
99.999	5	5.3 min
99.9999	6	31.5 s
99.99999	7	3.2 s
99.999999	8	0.3 s
99.9999999	9	1.57 cycles (50 Hz) 1.9 cycles (60Hz)

3.3 Environmental projects

Unceasing circulation of matter is ensured through constant maintenance, redirection and return to its original form. Dravske Elektrarne Maribor is taking every effort to preserve water's natural characteristics by maintenance of the Drava's reservoirs and embankments, ensuring living space for vegetation, wildlife and people, through well-planned environmental projects. Not only is their implementation important, but so is the manner of planning works that must be designed so that new ecological burdens are not placed on the environment [12].Follow projects are:

3.3.1Maribor Lake (Reservoir)

The Maribor Lake is an attractive recreational area. In the last decade, Dravske Elektrarne Maribor has successfully improved a number of tourist-recreational points on the lake. These include deeper moorings and the deepening of the lake floor for the boathouse and tourist facilities, the repair of tributary outlet, the creation of artificial islands, and the maintenance and expansion of tourism possibilities on the lake. During the maintenance work both here and at Ptuj Lake, the possibilities for water-related tourism and recreational use were taken into account.

3.3.2 Ptuj Lake (Reservoir)

The Ptuj Lake is an important refuge for migrating, rare and endangered species of birds, which have found a replacement habitat here. The lake also offers interesting recreational opportunities. Dravske Elektrarne Maribor has, through the thoughtful maintenance of valuable natural assets, set up a pilot program that includes the lining of banks and their landscaping.

3.3.3 Depot for Floating Debris

The current of the Drava River brings with it various types of floating debris, which can, during periods of high water, cause the blockage of turbine trash-racks and cause a decrease or even standstill in the generation of electric power (in short, also influencing the ecological status of the waters downstream). Therefore, Dravske Elektrarne Maribor cares about the effective removal of floating debris. Somewhere between 3000 and 8000 m^3 of floating debris is removed annually and is taken to a temporary depot within the fence area of the Zlatoličje Power Plant. Organic debris is treated like raw materials for additional processing – the ground up debris is used as humus.

3.3.4 Wild Sail

For the maintenance of hyroelectric facilities, inspection of dykes along all flows of the Drava River and for maintenance of parts of hydroelectric power plants and regarding ecologically significant works on reservoirs, Dravske elektrarne Maribor maintains a special working vessel, which already through its name draws attention to its ecological purpose. The Wild Sail (Anemone Sylvestris) is named after the vegetation found in wet regions. The environment of the boat are the reservoirs, potential growing spaces of plants bearing the same name and the Maribor otok where the flowers of the buttercup family had already bloomed for centuries.

3.3.5. Development Opportunity

Pumped storage hydroelectric power plant on the Drava river in the region of Kozjak is the most important development opportunity. The basic concept of a pumped storage power plant (PSPP) on the River Drava is to make use of natural conditions to produce electrical energy at a time of peak usage, also known as peak energy, as well as to enable better capacity utilization of power plants that produce band energy. PSPP will also serve as reserve power in case of a larger generation unit outage in the electro-energy system of Slovenia, while enabling control over network power and frequency at the same time. Basic technical data are:

Reservoir - useful volume	3 million m^3
Penstock	2400 m
Gross head	713,2 m

Net capacity	2 x 220 MW
Rated No. of revolutions	600 rev./min
Turbine	Francis - reversible
Annual generation	860 GWh
Connection of the hydroelectric power plant to the 400 kV Maribor substation	

4 Conclusion

Sustainable Management as a part of Business Excellence of Dravske Elektrarne Maribor (DEM) dictate the redefining of economic interests in the wake of the recognition, that the natural environment is a limited production factor. The activities are orientated to the whole proceeding. In a world where markets, products, technologies, competitors, regulations and even societies change rapidly, continuous innovation and have become important sources of sustainable competitive advantage [4]. It is about a new approach in managing the organisation and environment resource planning in society [5]. By the combination of inspections, assessments and improvements of processes, training and ongoing information for employees and ensuring that appropriate materials and other resources are available for the successful operation, the company guarantees the conformity of its activities with all the legal requirements and international standards so as to achieve all around business excellence[12]. Economically successful performance of hydroelectric power stations is conditioned on not only basic operating, production and maintenance of the undertaking, but also on additional subsystems such as supply, marketing, management, quality management, development, sustainable development etc. The result of good maintenance work is reliability of the equipment. To ensure reliability [19] and normal functioning of the equipment, and a high economic efficiency, a proper strategy of maintenance has to be predicted and organized. By introducing modern approaches to the strategy of maintenance and consequently reliability of functioning, a reduction by 50% in malfunctioning, and by 15% in the costs can be achieved[17]. Furthermore, the costs of spare parts can be reduced by 15% and the production failure due to malfunctioning by 10%. The results, obtained by making classical analyses, are 70% more expensive than by using preventive approach with the use of diagnostic inspection[17].

It could be said that with the right approach to sustainable development and maintenance we can:

- Reduce the costs of maintenance by decreasing the duration of work in connection with discovering and predicting malfunctions at an early stage, which helps us plan the resources and spare parts
- Consequently, the increase of production availability of equipment is achieved
- Motivate workers with efficiency
- Punctually ascertain weak spots in the system
- Transfer experience to planning new systems, which design devices of high reliability and those appropriate for maintenance[17].

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