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ORIGINAL PAPER

CONCEPT FOR MEASURING ORGANIZATIONAL MATURITY SUPPORTING SUSTAINABLE DEVELOPMENT GOALS

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ABSTRACT. **Background:** The following paper was developed to assess maturity levels in regards to sustainable development goals. Highly unstable business environment and opportunities occurring on the market require effective and quick decision making process. It is a challenge to follow such dynamic changes within and outside organization while maintaining sustainable goals. However authors state that this is possible thanks to modern concepts and available tools – Industry 4.0 concept or Business Intelligence to name only few. Those concept support making business decisions based on well gathered, analyzed data and setting sufficient strategy which promotes sustainable goals and allows organization to mature.
Methods: Authors based their own maturity model on identified in literature maturity models and international standard: PN-EN ISO 9004:2000.
Results: Authors have defined five maturity levels, each described with several features. On the basis of prepared tables one can define maturity level of organization. Additionally, further steps of development can be indicated and enforced in organizational strategy.
Conclusions: Application of sustainable development within organizational maturity can mitigate reaching sustainable targets. It is important to understand relations between maturity level of organization and sustainable development goals. By improving its maturity, organization should in parallel develop further sustainable measures.

Key words: Sustainable development, Business Intelligence, Industry 4.0., decision making, organizational maturity.

INTRODUCTION

Measuring organizational maturity has to be tailored to current situation observed in supply chains. Developing such system has to take into account current trends in development of technology and organization methods used in business. In the world full of information, highly unstable business environment and agile industry there is an urgent need to manage data correctly. Industry 4.0 seems to be a good solution for these challenges supporting industry and organizations in general. Industry 4.0 as a concept was presented in Germany in 2011 and was foreseen as a part of fourth industrial revolution [Kagermann et al.]. The concept was proposed as part of High-Tech Strategy 2020, Action Plan carried out by the German government. Within this term several models and ideas were developed, in particular Smart Factory, Internet of Things and Services, Cloud Computing or Cyber Physical Systems to name only the most common. Modern technologies, with high integration of supply chains with improved communication and wide customization opportunities are considered as base elements of Industry 4.0 concept which is also common outside Europe and known under different names e.g. Industrial Internet in USA [The Industrial Internet Consortium 2014] or Internet+ in China [Premier of the State Council of China 2015]. The main purpose of fourth industrial revolution is to improve quality of offered products and processes while meeting

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customers' requirements and adjusting to global markets at the same time. This is possible thanks to significant focus on communication and cooperation between people and machines in real time, production of small batches of highly customized products, flexible management of well automated processes and horizontal and vertical integration within company and supply chain [Prause and Weigand 2016]. It is expected that current industry will evolve towards the concept described within Industry 4.0 in following two years [Euromonitor International 2016] but it is also clear that, seeing advantages of implementation, some companies have already started using tools which make this evolution possible. Implementation of the Industry 4.0 concept requires not only usage of high-tech and artificial intelligence but also well designed network infrastructure, sufficient analytics software and smart controllers to use available data properly. Within Industry 4.0 cyber physical systems communicate efficiently not only within enterprise but also outside it integrating companies with customers and other users [Hermann et al. 2015]. The concept makes use of modern IT tools, being based on flexible, decentralized and intelligent structures of production inspection [Lee et al. 2017].

Authors understand sustainable development to be much broader term than Industry 4.0 concept. It is known since 1970s and has been defined differently due to intense development of socio-economic environment. Sustainable development focuses not only on area of industry but covers also construction, architecture, business, transport and consumption. Currently the idea of sustainable development functions as a way of satisfying the growing needs of the population while preserving the environment at the same time [Cash et al. 2003]. Despite relatively long functioning of the term 'sustainable development', the term is much more developed in theory than in practice which looks analogously to the Industry 4.0 term [Skowroński 2006]. Almost for the 20 years, the links between science, technology and sustainable development are noticed. The authors even argue that science and technology should play a central role in the implementation of the sustainable development concept [Cash et al. 2003].

To meet the needs related to the sustainable development concept goals, processes and sets of IT tools within industrial environment comes. These processes can be briefly described as those that transform stacks of raw data into clear information supporting decision making and analyzing activities within the enterprise. These processes are usually defined as the concept of Business Intelligence. Its main goal is a direct support in improving the results and increasing the efficiency of processes which take place in enterprises. Thanks to this it is possible to utilize resources within company more efficiently which directly supports the sustainable development concept for example in area of energy usage effectiveness. The full potential of Business Intelligence solutions requires a well-designed architecture of the entire data acquisition system, which consists of hardware and software. In the case of a production environment, it is a technical infrastructure that acquires data and consists of sensors controllers and computers connected directly to servers and databases. These data usually feed ERP or CRM systems. Thanks to a well-designed data warehouse, it is possible to aggregate and manage collected data in a way that proper analysis supports decision-making processes in business.

Decision making is a cognitive process of analyzing alternative solutions for a problem or particular situation with more than one explanation. Business decisions are being taken on the basis of well-gathered and analyzed data, understanding the whole scope of the problem, needs of organization, clients and also including all resources. Nevertheless it happens that business decision is taken without any research, on the basis of decider's feelings. Several researches have been made to proof that business analytics are supporting and improving decision making, however scientists still argue that business analytics leads to additional value in the process. [Sharma et al. 2014] Lack of available data, unknown relationships in analyzed systems, no clear goals and poorly understood risks lead to decision making based on intuition or experience only. Therefore, despite

discussions, authors admit that decision making process currently is a crucial part of business management and still appears to be a challenging task. [Pourshahid 2011] Decision making process within enterprise should support completing targets set within business model. Business model describes what value company is creating, where process is being held, how value is brought to client and captures mechanisms it employs. Business models are defining the way of bringing profit to the enterprise by describing the process from early stage of value creation until the final stage of payment for this creation. Therefore role of business model itself is foreseen as significant and closely connected with business strategy and also tactic and operational management [Teece 2010] and should be supported by efficient decision making processes.

SUSTAINABLE DEVELOPMENT WITHIN BUSINESS

Sustainable Development concept is the result of changed approach within the industry that began to pay attention to the natural environment and its relationship in late 1960s. The term of Sustainable Development concerns not only the area of industry, but is a much broader concept that takes into account many aspects related to human existence e.g. Climate Action, Life on Land or Below the Water, Affordable and Clean Energy or Decent Work and Economic Growth which stands as just a few of a Sustainable Development goals. In total SD Agenda assumes delivering 17 various goals which are directly related to the environment, economy and society aspects [United Nations]. In this paper the term of Sustainable Development will be defined as a concept which includes all aspects of human life based on social, economic and environmental pillars. Authors focus mainly on economic and environment impact of business activity and its role within this global strategy.

Since the beginning of 21th century links between science, technology and sustainable development are significantly noticed. Currently the thesis that SD should play the key role in business strategies is more common than few years before. Unfortunately, in most cases, the development of technology is still executed without green trends that prevent the degradation of natural environment. It can be observed that industrial and economic development of the regions was highly connected with environment degradation. The objectives of SD concept assume the economic and technical growth without negative impact on earth. Goals that are the closest to business activity are directly related to:

- efficient use of natural resources,
- reduced waste generation through prevention, reduction, recycling and reuse,
- development of top quality, reliable, sustainable and resilient infrastructure.

What is more it is desired to adopt sustainable practices and integrate sustainability information with economic units like companies within their reporting cycles.

Before understanding relations between sustainable development and business it is important to clarify how companies are measuring their performance. Usually it should be measured by defining and following key performance indicators. These evaluate success of activities or organization in general. KPIs are being regularly tracked and reviewed by management team. They are strictly connected to the business model and targets for the company. KPIs can have a form of quantitative measurement which is a specific value or objective, usually numeric measured or qualitative values which are influenced or based by subjective assessment. Examples for key performance indicators differ from business types. Nevertheless as authors focus on industry business following KPIs are usually used in manufacturing, to name only a few:

- Safety measured usually as a number of accidents in taken time unit
- Efficiency of equipment, often described as OEE (overall equipment effectiveness)
- Quality measured differently, as an example as Share of finished goods that are inspected by a quality unit and are in compliance with the inspection plan without further need of clarification, retesting or reworking and obtain a positive usage decision

- Production frequency (or availability) measured as days in between production of particular finished good.
- Utilization rates measured as a capacity versus demand of particular equipment
- MTBF / MTTR known as basic indicators for maintenance teams. MTBF (Mean Time Between Failure) refers to the amount of time that elapses between one failure and the next and MTTR (Mean Time To Repair) which represents the average time required to repair a failed component or device
- Stock coverage understood as a total demand that is covered by the gross value of stock in warehouses and stock in transit
- Costs detailing expenses for conversion of materials into finished goods

Most effectively key performance indicators should support reaching all sustainable development goals. Nevertheless authors state that such relation will appear only within highly mature organization which includes fully sustainable development in its strategy. To understand and specify features of sustainable development on each level of organizational maturity authors prepared description of each in following chapter.

SUSTAINABLE DEVELOPMENT WITHIN ORGANIZATION

In tables designed in following chapters, authors proposed combined approach for achieving sustainable development goals within key performance indicators. The reason behind such approach is that organization's primary target usually is defined by KPIs while sustainable development stands besides or is developed in parallel. Using proposed solution, authors believe that both targets can be reached easily. PN-EN ISO 9004:2000 distinguishes following levels of organizational maturity:

1. Level 1. No formal approach. Organization is not using any systematic approach to management. It does not measure results or measures are irrelevant.
2. Level 2. Reactive organization. Minimum required to achieve ISO 9001. Organization is taking conscious decisions based on simple measures.
3. Level 3. Stable, formalized approach. System approach to management. Organization is tracking key performance indicators and understands trends.
4. Level 4. Continuous improvement approach. Organization gains stability in improving results. Continuous improvement process is implemented.
5. Level 5. World class manufacturing. Organization is leading in specific market. Organization has highly integrated improvement process and its key performance indicators are usually higher than relevant measures of their competitors. Level 5 is usually reached by global companies.

Organizational maturity levels are well described in the norm PN-EN ISO 9004:2000. Since 2000 it has developed, including sustainable development in recent years (e.g. PN-EN ISO 9004:2018). This proofs that topic chosen by authors is valid and requires further attention.

ORGANIZATIONS MATURITY – RESEARCH FREAMWORK

General description of a model

To describe the maturity level of the organization authors decided to use the terms for the next levels of organizational maturity as Ignoring, Defining, Adapting, Managing and Integrating [16]. Each maturity level characterizes selected feature's level of advancement. The levels are described in the tables presented below. The following tables consist of 5 columns. First column divides features described in ISO norm (column 2) into 3 different evaluation areas: human factor, technical/organizational and management. In third column characteristic of each feature on particular organizational maturity level is described in details. The description of each characteristic is based on ISO norm. According to those authors has chosen KPI proposals (column 4) for tracking and measuring each feature and sustainable targets which might be achieved within the feature. Sustainable development goals included in tables were addressed officially by United Nations as

"blueprint to achieve a better and more sustainable future for all".

Goals are listed as follows: Goal 1: No Poverty, Goal 2: Zero Hunger, Goal 3: Good Health and Well-Being, Goal 4: Quality Education, Goal 5: Gender Equality, Goal 6: Clean Water and Sanitation, Goal 7: Affordable and Clean Energy, Goal 8: Decent Work and Economic Growth, Goal 9: Industry, Innovation and Infrastructure, Goal 10: Reduced Inequalities, Goal 11: Sustainable Cities and Communities, Goal 12: Responsible Production and Consumption, Goal 13: Climate Action, Goal 14: Life Below Water, Goal 15: Life On Land, Goal 16: Peace, Justice and Strong Institutions, Goal 17: Partnership for the Goals.

Maturity levels

Features and characteristics describing organizations on first level of maturity level are described in the Table 1 that shows also business KPIs and sustainable targets supported by improving particular feature. This level of maturity authors describe as "Ignoring Level" as in Oleskow-Szłapka and Stachowiak [2019]. The truth is that at this level organization is not using any business KPIs or measures are really basic according to the norm. (ISO-9004:2018(E)) Sustainable development as a concept does not exist either however some aspects are being developed or addressed in informal manner.

Table 1. Maturity level 1

Evaluation area	Feature	Characteristic	Business KPI	Sustainable targets
Human factor	9.5 Work environment	Work environment needs related to sustainable development are addressed in informal and ad hoc manner.	Physical factors like humidity noise or heat compliance	Goal 3
	9.2 People	Competent and engaged people are considered to be resource. There are some informal processes related to competence development.	N/A	Goal 8
	7.4 Communication	Communication about sustainable development strategy and objectives within organization is informal and had hoc.	N/A	Goal 8
	6.2 Mission, vision, values, culture	A process of determination vision and values related to sustainability is informal and ad hoc.	N/A	Goals: 3, 5, 8, 10, 13, 14, 15
Technical / organizational	9.7 Natural resources	Organization does not manage the use of natural resources and does not consider the impact of it. The only use of natural resources comes from current process needs.	N/A	Goals: 7, 9, 11, 12, 13, 14, 15
	9.5 Infrastructure	Infrastructure needs related to sustainable development are addressed in informal and ad hoc manner.	N/A	Goals: 7, 8, 9
	9.4 Technology	Advances in current technology used within organization are informal and irregular.	N/A	Goals: 7, 8, 9, 11, 12, 13, 14, 15
Management	9.1 Resource management	Improving and supporting the operation in organization are performed in an informal manner. Some objectives are determined.	N/A	Goal 7, 9, 11, 12
	9.3 Organizational knowledge	Current knowledge is captured in an informal or ad hoc manner. Processes to improve the situation are informal.	N/A	Goals: 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15
	10.3 Performance analysis	Performance analysis is made in ad hoc manner. The analysis are made in event type way rather than process.	N/A	Goals 8, 9
	10.5 Self-assessment	Internal audits are reactive in response to problems and issues.	Number of audits per year	Goals: 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15

Source: own work based on ISO 9004:2018(E)

Features and characteristics describing organizations on second level of maturity level are described in the Table 2 that shows also business KPIs and sustainable targets supported by improving particular feature. This level of maturity authors describe as "Defining Level". Sustainable development on this level of maturity appears to be an issue. It is starting to be defined and good practices are being implemented.

Table 2. Maturity level 2

Evaluation area	Feature	Characteristic	Business KPI	Sustainable target
Human factor	9.5 Work environment	Some processes for addressing work environment issues are in place.	Physical factors like humidity noise or heat compliance	Goal 3
	9.2 People	Processes to attract competent and engaged people are in place. There are some processes related to competence review and development plans.	N/A	Goal 8
	7.4 Communication	There is a procedure for communicating selected information about sustainable development. There is a process for determination the types and degrees of needed communication.	N/A	Goal 8
	6.2 Mission, vision, values, culture	A basic understanding of organization mission and vision related to sustainable development is in place. The understanding of the need of change is informal.	N/A	Goals: 3, 5, 8, 10, 13, 14, 15
Technical / Organiza-tional	9.7 Natural resources	Organization implements good practises in current procedures of usage of natural resources.	N/A	Goals: 7, 9, 11, 12, 13, 14, 15
	9.5 Infrastructure	Some processes for addressing infrastructure issues are in place.	% effectiveness of equipment usage; MTBF / MTTR	Goals: 7, 8, 9
	9.4 Technology	Some of the processes related to innovation and development are in place.	N/A	Goals: 7, 8, 9, 11, 12, 13, 14, 15
Manage-ment	9.1 Resource management	Some of the processes within organization on basic level focus on efficient usage of resources. Risk and opportunities assessment is set on a basic level. Process of determination and management of needed resources exists. Efficient use of resource is not defined.	% of processes covered with resource management approach.	Goals: 7, 9, 11, 12
	9.3 Organizational knowledge	Some processes for protecting and documenting organizational knowledge exist.	N/A	Goals: 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15
	10.3 Performance analysis	Limited analysis of the performance. Some basic tools are in use.	Cost per unit; % of machine effectiveness; Productivity hours/unit	Goals: 8, 9
	10.5 Self-assessment	Internal audits for key processes are managed systematically. Data are used in preventive way.	Number of non-conformities	Goals: 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15

Source: own work based on ISO 9004:2018(E)

Features and characteristics describing organizations on third level of maturity level are described in the Table 3 that shows also business KPIs and sustainable targets supported by improving particular feature. This level of maturity authors describe as “Adapting Level”. In this level of maturity mission, vision and values of organization are based on sustainable development concept. Processes are ensuring effective resources management. Performance is being tracked and analyzed with sustainability behind.

Table 3. Maturity level 3

Evaluation area	Feature	Characteristic	Business KPI	Sustainable targets
Human factor	9.5 Work environment	Processes that address risks and opportunities for the work environment are in place. There are activities that measure, monitor and protect infrastructure and work environment.	Physical factors like humidity noise or heat compliance	Goal 3
	9.2 People	Transparent, ethical and socially responsible approach is applied at all levels of the organization. Revision of the actions effectiveness is aligned with the mission vision and objectives.	Associates development plan - % of succession Level of satisfaction	Goal 8
	7.4 Communication	Communication processes are defined and in meaningful manner facilitate process that is tailored to different recipients in accordance to sustainable development concept. A feedback mechanism is present in place.	N/A	Goal 8
	6.2 Mission, vision, values, culture	Top management is involved in determining the mission vision and values based on sustainable development concept. The need of change of current situation is in place. Changes of the organization identity are communicated informally to interested recipients.	N/A	Goals: 3, 5, 8, 10, 13, 14, 15

Evaluation area	Feature	Characteristic	Business KPI	Sustainable targets
Technical / organizational	9.7 Natural resources	Management of natural resources is linked with organization management system. There is evidence in improving the actual use of natural resources measured by some indicators.	% use of natural resources.	Goals: 7, 9, 11, 12, 13, 14, 15
	9.5 Infrastructure	Processes that address risks and opportunities for the infrastructure is in place. There are activities that measure, monitor and protect infrastructure.	Total operating capacity value for key equipment; % effectiveness of equipment usage; MTBF / MTTR	Goals: 7, 8, 9
	9.4 Technology	There is a process of evaluating the benefits and risk related to implementation of suitable solutions linked with sustainable development concept. Cost, savings and other benefits assessment is in place.	% of effectiveness and cost improvement vs. previous year.	Goals: 7, 8, 9, 11, 12, 13, 14, 15
Management	9.1 Resource management	Some of the processes within organization focus on efficient usage of resources. Resource management approach is implemented systematically within organization.	% of processes covered with resource management approach.	Goals: 7, 9, 11, 12
	9.3 Organizational knowledge	Some of the processes are documented and described. There are activities that determine whether the knowledge is explicit or hidden. There is a process of identifying important information and distributing them through organization.	% improvement of processes described vs. previous year.	Goals: 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15
	10.3 Performance analysis	Performance is analysed to identify issues and opportunities. Statistical tools are used for support analysis.	Cost per unit; % of machine effectiveness; Productivity hours/unit; % of materials usage effectiveness; Joules/ Unit; Media usage/unit	Goals: 8, 9
	10.5 Self-assessment	Audits are made in a consistent way by the 3rd party personnel. Audits identify problems and nonconformities.	% of non-conformities; % of improvements vs. current state	Goals: 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15

Source: own work based on ISO 9004:2018(E)

Features and characteristics describing organizations on forth level of maturity level are described in the Table 4 that shows also business KPIs and sustainable targets supported by improving particular feature. This level of maturity authors describe as "Managing Level". In this level of maturity whole organization is starting to understand and follow sustainable goals. Organization's culture is aligned with mission, vision and values of sustainable development.

Table 4. Maturity level 4

Evaluation area	Feature	Characteristic	Business KPI	Sustainable targets
Human factor	9.5 Work environment	Processes implements advanced techniques to improve performance and resource usage efficiency. There is proactive manner into implementation process.	Physical factors like humidity noise or heat compliance	Goal 3
	9.2 People	People across the organizations are aware of their personal development. Career planning is well developed. Information and knowledge are accessible for employees and teamwork within organization is seen and present. Competence development is made for achieving new skills.	Associates development plan - % of succession Level of satisfaction	Goal 8
	7.4 Communication	The processes of communicating the strategy and objectives related to sustainable development are regular and show a direct relationship to the context of the organization.	% of changes within organization communicated	Goal 8
	6.2 Mission, vision, values, culture	Organization's culture is aligned with mission, vision and values of sustainable development. Understanding of the current culture and the need for a change is evident. Changes of any key factors are communicated.	N/A	Goals: 3, 5, 8, 10, 13, 14, 15
Technical / organizational	9.7 Natural resources	The organization knows its responsibility to society for managing natural resources. Some best practise solutions have been implemented within organization.	% use of natural resources. % efficiency of resource usage	Goals: 7, 9, 11, 12, 13, 14, 15
	9.5 Infrastructure	Processes implements advanced techniques to improve performance and resource usage efficiency. There is proactive manner into implementation process.	Total operating capacity value for key equipment; % effectiveness of equipment usage; MTBF / MTTR; 3 year roadmap with initiatives	Goals: 7, 8, 9
	9.4 Technology	Organization's knowledge and resource capability needed to implement innovation solutions and asses the risks and opportunities are in place.	% of spent funds for sustainability projects; % of spent funds for efficiency improve projects	Goals: 7, 8, 9, 11, 12, 13, 14, 15

Evaluation area	Feature	Characteristic	Business KPI	Sustainable targets
Management	9.1 Resource management	Controls to support the efficient usage of resources are in place. External providers are encouraged by organization to improve usage effectiveness of the resources. Strategic planning processes are aligned with organization's objectives in order to achieve efficient performance.	% of utilization of the resource.	Goals: 7, 9, 11, 12
	9.3 Organizational knowledge	There are processes of gathering and analysing data. The process of staff understanding evaluation is present. There are methods of communication the roles and owners of managed processes.	% of processes described within the system vs. previous year.	Goals: 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15
	10.3 Performance analysis	Performance is analysed to identify weaknesses within the processes: Insufficient resources, Insufficient competences, Defining "the role model" processes to share with other parties. The analysis and results are shown with interested parties.	Cost per unit; % of machine effectiveness; Productivity hours/unit; % of materials usage effectiveness; Joules/Unit; Media usage/unit; Leading and Lagging indicator system for key contributors.	Goals: 8,9
	10.5 Self-assessment	The organization is prepared to review all internal audit reports to prepare corrective actions.	% of non-conformities % of ; improvements vs. current state; % of improvement vs. previous year	Goals: 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15

Source: own work based on ISO 9004:2018(E)

Features and characteristics describing organizations on fifth level of maturity level are described in the Table 5 that shows also business KPIs and sustainable targets supported by improving particular feature. This level of maturity authors describe as "Integrating Level". This is highest level of sustainable development integration within organization. Sustainable targets are being reached in different areas, by different features.

Table 5. Maturity level 5

Evaluation area	Feature	Characteristic	Business KPI	Sustainable targets
Human factor	9.5 Work environment	The work environment is managed in a way that allows, support and not disturb in achieving desired results.	Physical factors like humidity noise or heat compliance and all related to ergonomics and comfort at work.	Goal 3
	9.2 People	People across the organizations take part within the development of the processes related to achieving sustainability. The results achieved for competent, engaged and empowered people are shared within the organization and compared with other organizations.	Associates development plan - % of succession Level of satisfaction	Goal 8
	7.4 Communication	The processes of communicating the strategy and objectives related to sustainable development are dynamic with the interrelationships of the strategy or objectives. They are clearly conveyed to all recipients and accounts their different needs related to changes.	% of changes within organization communicated	Goal 8
	6.2 Mission, vision, values, culture	A process of reviewing these elements by top management is regular and maintained. The analysis and consideration includes both internal and external factors related to sustainable development concept to ass alignment of between the business objectives and the concept.	% of review made on time.	Goals: 3, 5, 8, 10, 13, 14, 15
Technical / organizational	9.7 Natural resources	The organization knows its responsibility to society for managing natural resources and the lifecycle of their products. Management of natural resources is widely recognized as important in whole organization what is more the future role of the resource usage is very well known and practised. New technologies and trends are very important part of the strategy for maximizing the efficiency of resource usage.	% use of natural resources; % efficiency of resource usage; number of new initiatives related to natural sources	Goals: 7, 9, 11 ,12, 13, 14, 15
	9.5 Infrastructure	Infrastructure is managed in a way that becomes a key contributor in achievement of desired results.	Total operating capacity value for key equipment; % effectiveness of equipment usage; MTBF / MTTR; 5 year roadmap with initiatives	Goals: 7, 8, 9
	9.4 Technology	Organization takes measures to keep informed of new technologies and methods and evaluate their possible benefits and impact on organization and sustainable development goals.	% of spent funds for sustainability projects; % of spent funds for efficiency improve projects	Goals: 7, 8, 9, 11, 12, 13, 14, 15

Evaluation area	Feature	Characteristic	Business KPI	Sustainable targets
Management	9.1 Resource management	The cooperation with external providers of the resources depends on joint initiatives to implement improvements on the usage of the resources.	% of utilization of the resource.	Goals: 7, 9, 11, 12
	9.3 Organizational knowledge	There are processes of gathering and analysing data for every area and process that organization is interested in and helps to track impact on sustainable development targets and goals.	% of processes described within the system	Goals: 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15
	10.3 Performance analysis	Performance is analysed comprehensively within the organization by numbers of indicators to strengthen the leadership activities or identify weaknesses within the processes. The analysis can cover all areas that drive the main areas of interest within organization that shows the effectiveness of the system e.g. Profits and Losses, machines utilisation or customer service indicators.	Cost per unit; % of machine effectiveness; Productivity hours/unit; % of materials usage effectiveness; Joules/Unit; Media usage/unit; Leading and Lagging indicator system for key contributors.	Goals: 8, 9
	10.5 Self-assessment	The organization is prepared to control itself internally to identify weaknesses and address corrective actions for improvement to be back on its standards.	% of non-conformities % of improvements vs. current state % of improvement vs. previous year	Goals: 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15

Source: own work based on ISO 9004:2018(E)

CONCLUSIONS

Application of sustainable development within organizational maturity can mitigate reaching sustainable targets. Authors therefore described basic assumptions in the table 6 which is a summary of previous, detailed tables of each maturity level. It is important to understand relations between maturity level of organization and sustainable development goals. By improving its maturity, organization should in parallel develop further sustainable measures.

Table 6. Maturity levels summary

Organizational maturity level and name	Functional description within sustainable development
Level 1: Ignoring	Procedures of working according to sustainable development concept do not exist. There are no sustainable activities or informal and immature activities appear. Regarding sustainable development no measures are applied and no data is being gathered.
Level 2: Defining	Key processes and procedures related to sustainable development are being defined. First approach of including sustainable development into strategy. Goals area being measured. Data is being partially gathered and analyzed.
Level 3: Adapting	Key performance indicators are built on the basis of effective resource management and sustainable development. Organizational goals are highly related to usage of resources and are being spread across several departments.
Level 4: Managing	Some best practice solutions have been implemented within organization for managing natural resources. The performance of the processes are evaluated and improved systematically while using opportunities and managing risks. Sustainable development is being supported and plays significant role in managing organization.
Level 5: Integrating	Sustainable development goals are highly interlaying organizational strategy. The processes are designed in a way that allow to achieve demand performance effectively and efficiently within sustainable development concept and on the basis of performance which is analyzed comprehensively, on regular basis. New technologies and trends are playing important part of the strategy. Both external and internal resources are being used to ensure higher sustainability. Knowledge level within the crew is measured and developed constantly.

Source: own work

Authors state that more and more organizations are developing towards highest maturity levels including and implementing sophisticated measures and tools to make it feasible. Despite current maturity level, tables shown within paper should contribute in measuring current status of organizational development and help with describing further steps of development.

In the further research authors are going to precise via quantitative research business KPI values (targets) on each maturity levels. When all the values will be identified model will be ready to its validation across companies.

For sure one of key development features is usage of Business Intelligence within industry (use to identification values of business KPI's).

Business Intelligence should allow to gather and analyze complex data supporting operational processes on every organizational level. Data gathered continuously in various areas should be analyzed anytime. History of data should be stored safely for general summaries of longer periods. Analysis of different periods should be enabled automatically. User should have possibility to view situation of each resource in any moment, from the beginning of operation.

Analysis of maturity level in area of sustainable development have to take into consideration current trends in supply chain development. Implementation of the Industry 4.0 concept require not only usage of high-tech and artificial intelligence but also well designed network infrastructure, sufficient analytics software and smart controllers to use available data properly. All those features will support reaching of sustainable development goals.

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REFERENCES

Cash D., Clark W., Alcock F., Dickson N., Eckley N., Guston D., Jager J., Mitchel R., 2003. Knowledge systems for sustainable development. Proceedings of the national academy of sciences of the United States of America, 100 (14), 8086-8091. http://doi.org/10.1073/pnas.1231332100.

Euromonitor International, 2016. Industry 4.0: The Future Impact of the Fourth Industrial Revolution, Available from Internet: http://www.euromonitor.com/industry-40-the-future-impact-of-the-fourth-industrial-revolution/report (accessed on 18.10.2018).

Hermann M., Pentek T., Otto B., 2015. Design Principles for Industrie 4.0 Scenarios: A Literature Review, Technische Universität Dortmund Fakultät Maschinenbau, Working Paper 01.

ISO 9004:2018, Quality management - Quality of an organization - Guidance to achieve sustained success

Kagermann H., Wahlster W., Helbring J., 2018. Securing the Future of German Manufacturing Industry: Recommendations for Implementing The Strategic Initiative Industrie 4.0. Final report of the Industrie 4.0 Working Group. Available from Internet: http://www.acatech.de/fileadmin/user_upload/Baumstruktur_nach_Website/Acatech/root/de/Material_fuer_Sonderseiten/Industrie_4.0/Final_report__Industrie_4.0_accessible.pdf (accessed on 15.10.2018).

Lee J., Jin C., Bagheri B., 2017. Cyber physical systems for predictive production systems. Production Engineering April 2017, 11(2), 155–165. http://doi.org/10.1007/s11740-017-0729-4

Oleśków-Szłapka J., Stachowiak A. 2019. The framework of Logistics 4.0 Maturity Model, in: Burduk A., Chlebus E., Nowakowski T., Tubis A. (Eds), Intelligent Systems in Production Engineering and Maintenance, 771-781.

Pourshahid A., Richards G., Amyot D. 2011. Toward a Goal-Oriented, Business Intelligence Decision-Making Framework. in: Babin G., Stanoevska-Slabeva K., Kropf P. (Eds) E-Technologies: Transformation in a Connected World. MCETECH 2011. Lecture Notes in Business Information Processing, 78. Springer, Berlin, Heidelberg. http://doi.org/1000038vd036f.han3.library.put.poznan.pl/10.1007/978-3-642-20862-1_7

Prause M., Weigand J., 2016. Industry 4.0 and Object-Oriented Development: Incremental and Architectural Change, Journal of Technology Management & Innovation, 11(2), 104-110.

Premier of the State Council of China and Li K. Q., 2015. Report on the work of the government, in Proceedings of the 3rd

Session of the 12th National People's Congress, March 2015.

Sharma, R., Mithas S., Kankanhali A. 2014. Transforming decision-making processes: a research agenda for understanding the impact of business analytics on organisations. European Journal of Information Systems, 23, 433-441 http://doi.org/10.1057/ejis.2014.17.

Skowroński, A. 2006. Sustainable development as the perspective of further civilisation development. Problemy ekorozwoju 1(2), 47-57.

Teece D. 2010. Business Models, Business Strategy and Innovation. Long Range Planning 43(2-3), 172-194. http://doi.org/10.1016/j.lrp.2009.07.003

The Industrial Internet Consortium 2014. A Global Nonprofit Partnership of Industry, Government and Academia, 2014, Available from Internet: http://www.iiconsortium.org/about-us.htm (accessed on 18.04.2017).

United Nations, Sustainable Development Goal, Available from Internet: https://www.un.org/sustainabledevelopment/sustainable-development-goals/ (accessed on: 21.11.2018).

KONCEPCJA OCENY DOJRZAŁOŚCI ORGANIZACYJNEJ WSPIERAJĄCEJ CELE ZRÓWNOWAŻONEGO ROZWOJU

STRESZCZENIE. **Wstęp:** Celem artykułu jest zaprezentowanie modelu oceny poziomów dojrzałości organizacji w odniesieniu do celów zrównoważonego rozwoju. Bardzo niestabilne otoczenie biznesowe i możliwości pojawiające się na rynku wymagają efektywnego i szybkiego procesu decyzyjnego. Wyzwaniem jest śledzenie tak dynamicznych zmian wewnątrz i na zewnątrz organizacji przy zachowaniu trwałych celów. Autorzy zauważają, że jest to możliwe dzięki nowoczesnym koncepcjom i dostępnym narzędziom – takim jak przemysł 4.0 czy Business Intelligence. Te koncepcje wspierają podejmowanie decyzji biznesowych w oparciu o zebrane i przeanalizowane dane, określając odpowiednią strategię, która promuje cele zgodne ze zrównoważonym rozwojem.
Metody: Autorzy oparli swoją koncepcję modelu dojrzałości organizacji na opisanych w literaturze modelach raz na międzynarodowym standardzie (jego polskiej wersji): PN-EN ISO 9004:2000.
Wyniki: Autorzy zdefiniowali pięć poziomów dojrzałości, z których każdy opisany został kilkoma cechami. Na podstawie przygotowanych wytycznych można zdefiniować poziom dojrzałości organizacji.
Wnioski: Istotnym aspektem jest zrozumienie relacji między poziomem dojrzałości organizacji a celami zrównoważonego rozwoju. Opracowany model pozwala na włączenie elementów zrównoważonego rozwoju do oceny poziomu dojrzałości organizacji.

Słowa kluczowe: zrównoważony rozwój, Business Intelligence, przemysł 4.0., proces podejmowania decyzji, dojrzałość organizacji

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