

# Flexible man-man motivation performance management system for Industry 4.0

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**Abstract-**Many companies are oriented on the 4<sup>th</sup> industrial revolution, they solve daily a lot of new working situation in management and organization of own production processes. The purpose of this paper is to present methodological tool for motivation of own staff by implementation of Industry 4.0 concept. There is most important by this concept to manage and lead all employees for effective and profitable communication with e-technologies used in company. Important dates for the methodology proposal were taken from surveys realized in selected industrial companies (2014, 2015), oriented on the implementation of Industry 4.0 concept in 3 countries. According to results achieved, quantitative and qualitative analyses were realized and identified core motivation trends for effective e-processes. Presented results show key parameters and orientation strategies for flexible employees motivation, integrated in process teams in the area of production planning and organization. There is important to use various motivation strategies, dependent from the process – product – personality motivation of employees. This methodology proposal has the limitations in the small amount of companies that have implemented Industry 4.0 concept. If we are interesting on the new production management strategies in this environment, we should take positive and negative feedback from existing companies for effective new man-man strategies connected with e-processes. The research and results presented in this article open new ways of managerial strategies for production departments and industrial enterprises in the era of 4<sup>th</sup> industrial revolution. Many companies focus their attention solely on the implementation of e-technologies and e-processes, while still pay less attention to an equally important element – human. In practice will help this methodology to optimize man-man cooperation and teamwork for profitability of complex e-production systems and e-technologies. This paper extends managerial strategy configuration model highlighting new ways of man-man strategies that motivate company employees effective to cooperate with new-implemented e-technologies in according to achievement of optimal process performance.

**Keywords-** motivation; process; industry 4.0; production planning; organization

## 1. INTRODUCTION

Modern production concepts dispose with a strong potential to change the way factories work. It may be too much to say that it is another industrial revolution. Traditional production concepts were oriented on high productivity, low cost and acceptable customer time. Most of new digital technologies have been brewing for some time. A lot of manufacturing companies have great potential for improvement in the area of “human-machine interfaces” and in man-man interfaces according effective digital technologies utilization. We surveyed more than 300 manufacturing companies during 2014-2015; only 25% of manufacturers consider themselves ready for Industry 4.0. The coming of steam power and the rise of robotics resulted in the outright replacement of 60 to 75 percent of industrial equipment. Companies should be able to plan, organize and manage new process

technologies effective with other way of thinking about processes, dependencies, people and technologies management. One kind of lost value that is sure to interest manufacturers is process effectiveness. Industry 4.0 offers new tools for smarter production planning, greater information exchange between departments and real-time yield optimization in the completely production chain without minimum bottlenecks and wastes. Industrial companies and their industrial processes need to adapt to this rapid change if they are not to be left behind by developments in their sector and by their competitors. The biggest challenge of the digital transformation is going to be guaranteeing that different systems communicate with each other (Marcel Wenzin, agta recorg ag, Head of Supply Chain Management, 2014).

Core goal of this paper is to present the model of flexible man-man motivation performance management system

for Industry 4.0. Productivity, efficiency and profitability of modern production systems depends from the man ability to solve sophisticated tasks. An important factor is that the staff of specialized enterprise departments in industrial companies design, plan, organize and control the job and work of automated industrial systems. The real output from this automated machines and computer systems, working with the concept of Industry 4.0, are real processes and products.

## 2. THEORETICAL BACKGROUND

People management, people leadership in times of 4<sup>th</sup> industrial revolution brings the new way of thinking and processing not only by e-technologies, it also requires other access to the optimal performance management by employees. All industrial companies have a lot of experiences with various models of people management in traditional production processes, but in strong connection with e-technologies we should find new concepts, based on the right compatibility of e-technologies and people. Of particular importance there is the understanding of new type of process communication: e-technology cooperates with staff, staff should understand on right way the abilities and potentials of new technology.

If flexibility is an important concept in operations management, it should be explored in all types of operation, not just in manufacturing. Now, more than 80 per cent of economic activity and employment occurs in non-manufacturing enterprises. Flexibility is no different from most other topics in operations in that it is unreasonably skewed towards the manufacturing sector, it would nevertheless benefit from more empirical and conceptual work in the context of service operations (Nigel Slack, 2005)[23].

Claims that the most important demands on managers in sociotechnical organized systems with more or less autonomous work groups are generally that they must have a basic trust in their subordinates and their capacity and development potential, that they must be able to set goals for the activities within the groups and let the group members be responsible for the fulfillment of the production target and thus give up exercising a detailed control over the job procedure, and that they must realize the necessity to provide the group members with all kinds of basic data which are needed for the decision making within the group. At the transition from a traditional to a group-based organization, the manager must display a real commitment as change agent during the whole implementation period (Sigvard Rubenowitz, 1992)[26].

Future research directions include the measurement of organizational culture in firms that have implemented lean processes. This would be a step toward looking at the effect that the different quadrants in the Competing Values Framework have on various elements of lean efforts. This would take a significant amount of work, because the manufacturing industry, the leader in implementing and sustaining lean processes, may have institutionalized particular organizational cultures. It would be an interesting step forward in the understanding of how lean processes are operationalized across different firms and industries. However, there are multiple ways to examine culture; the authors believe this method allows the capture of the entire spectrum (Pakdil, Leonard, 2015)[5].

The amount of resources assigned to a task highly influences its processing time. Traditionally, different functions have been used in order to map the processing time of the task with the amount of resources assigned to the task. Obviously, this relation depends on several factors such as the type of resource and/or decision problem under study. Although in the literature there are hundreds of papers using these relation over another one. In some cases, even wrong justifications are given and, hence, infeasible or non appropriated relations have been applied for the different problems (Fernandes-Viagaz, Framinan, 2015)[28].

In order to promote business process management, it is necessary to have an organizational approach that defines the necessary tasks of the processes, projects, day-to-day execution, and learning-related tasks. In this aspect, there are difficulties and barriers to be confronted in a different way through organization (Aparecida da Silva, Pelogia, Damian, Dallavale de Pádua, 2012). The value of the principles lies in providing normative advice to practitioners as well as in identifying open research areas for academia, thereby extending the reach and richness of business process management beyond its traditional frontiers (Brocke, Schmiedel, Recker, Trkman, Mertens, Viaene, 2014)[11].

Organizations need to measure the degree to which they are endowed with the capability of managing effectively customer knowledge in order to foster innovation (Belkahla, Triki, 2011)[29]. Organizations generally have diverse value systems when building their codes of professional ethics for examining ethical principles, whereas Lean Management has established base principles with different codes of professional ethics differing from the intrinsic values humans create according to moral philosophy (Ljungblom, 2014)[22].

The analysis highlighted the different effects of demand variability and volumes on the leanness score and its different components leading to various demand and production management recommendations in this dynamic environment. Furthermore, the conducted analysis revealed some new aspects in understanding the relation between demand (variability and volume) and the leanness level of the systems (Ahmed, Deif, 2016)[25]. Fuzzy is an appropriate model method when uncertainty is present. It also allows modeling of a significant number of performance metrics across multiple supply chain elements and processes. Competitive strategy can be achieved by using a different weight calculation for different supply chain situations (Zaman, Ahsan, 2014)[14].

The best way to simplify performance management is to recognize that it has been approached from the dimensions of people and process for years. The people dimension considers how to get the best out of people and the way they interact with each other. The process dimension is about formal mechanisms for executing strategy and tracking the more quantifiable aspects of performance (Wilkes, Yip, Simmons, 2011)[12]. Most research works about the multi-manned assembly line balancing problems are focused on the conventional industrial measures that minimize total number of workers, number of multi-manned workstations or both (Yilmaz, 2015)[8].

The tightening competition and performance pressure in companies often leave no time or space for the assessment of business impacts of different investments and projects. In addition, in many cases the assessment may be challenging and there is no experience available to undertake it. Despite that companies often commit to different projects and investments without careful planning and vision of the costs it may cause (Heikkilä, 2015)[27]. Drawing on empirical evidence and economic production theory, it explores the spatial links between economic growth, innovation and knowledge productivity. It argues that the growing role of human capital in the production process has linked productivity to a city's mix and levels of infrastructure and amenities. It reviews five key infrastructure types for knowledge-based developments (Martinus, 2010)[16].

The vision of future production contains modular and efficient manufacturing systems and characterizes scenarios in which products control their own manufacturing process. This is supposed to realize the manufacturing of individual products in a batch size of one while maintaining the economic conditions of mass production. Tempted by these future expectations, the

term "Industry 4.0" was established ex-ante for a planned "4<sup>th</sup> industrial revolution", the term being a reminiscence of software versioning (Heiner, Fettke, Kemper, Feld, Hoffman, 2014)[17].

Industry 4.0 can progress if there is close exchange between the fields of electronics, electrical engineering, mechanical engineering and IT. With this approach Germany has special strengths as the "factory outfitter of the world". These strengths are based on the country's good general education system, its established development partnerships between suppliers and users, its market leadership in plant and mechanical engineering, its strong and dynamic SMEs and its position as the leading innovator in automation methods (Heng, 2014)[9]. The increasing integration of the Internet of Everything into the industrial value chain has built the foundation for the next industrial revolution called Industry 4.0. Although Industry 4.0 is currently a top priority for many companies, research centers, and universities, a generally accepted understanding of the term does not exist (Hermann, Pentek, Otto, 2016)[10].

Whereas the initial point of all past industrial revolutions can be located in the industry, they resulted in a tremendous change in society. In the present industrial revolution it is the other way around: Reviewing the beginning of the current transformation process, it is not driven by the production industry itself. Instead one of its main drivers is the invention of social networks and smart devices in combination with the employees' appealing to it. This development of interconnectivity pushes into the industrial sector today. For instance, there exists a desire of employees to bring their own device to work. According to a survey by Accenture 82 percent of the Chinese respondents would be "more resourceful" if they chose their own hardware and software for work. The first three revolutions had a strong focus on the shop floor. This is also true for the present industrial revolution: The public view is merely on its impact on production processes. Therefore, this paper expands this view and additionally analyses the effects of the relating transformation processes to the indirect departments (Schuh, Potente, Wesch-Potente, Weber, Prote, 2014)[7].

### 3. RESEARCH RESULTS

In according to map the actual trends by industrial enterprises oriented on the implementation of Industry 4.0 concept, we had realize during 2013-2015 one survey oriented on the state of implementation and experiences with this concept. Respondents were 300 industrial companies from the automotive sector (83 companies), mechanical engineering sector (87 companies), electrical

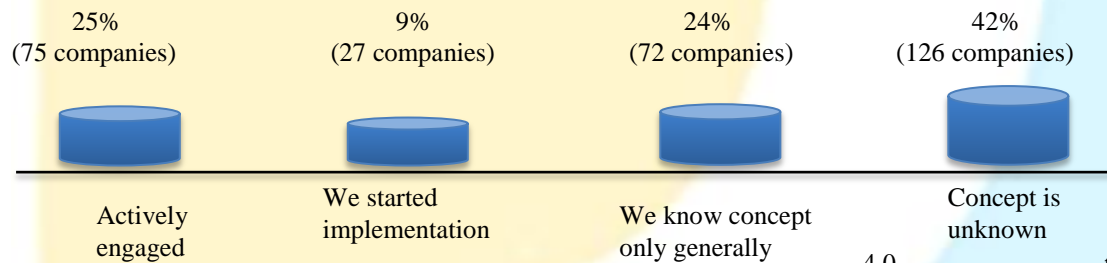


engineering sector (48 companies), chemical industry (42 companies) companies) and food industry (40 companies). This study sets out the key factors in international companies in Czech and Slovak Republik and Czech and Slovak manufacturing companies face in achieving the digital transformation of their industry and benefitting from exponential e-technologies integrated in the Industry 4.0 concept.

In our survey firstly we were asking on the motivation of each industrial company for implementation of Industry 4.0 concept. A few companies argue that industry 4.0 is something new, they haven't clear vision, how they will implement core pillars of this concept, but they see the possibility of significant progress in according to new technologies of process realisation and radical technological innovations. Our survey showed that the effort to implement this new concept is in partial progress

and the companies will see clear progress and future potential of real process and production outputs and return on investment new market chances in future. Only 2% of respondents perceived the role of mutual communication of staff and teamwork as a key issue in e-processes, important there was a fact, that Industry 4.0 concept perceived as only e-technology, which isn't connected with the people communication through new level of mutual communication. Characteristic of this survey is the knowledge (by 94% of respondents), that data and information about processes, products are also available by all departments In clear, stabile and correctly version. The core motivation for implementation of Industry 4.0 concept is the availability of these dates and information in real time for flexible process management.

1. Question: Dealing your company with implementation of Industry 4.0 concept?



2. Question: If you are actively engaged or you are started implementation, which tools from Industry

4.0 they actively use? (list of top 10 tools from the survey, answers: 75 companies – A category, 27 companies – B category)

Industry 4.0 tool	Implemented yet	Planned for implementation in next 2 years
Robotics	A – 18% (14 companies)	A – 56% (42 companies)
	B – 52% (14 companies)	B – 67% (18 companies)
Mobil equipment, communication tablets, visualisation tables	A – 16% (12 companies)	A – 36% (27 companies)
	B – 74% (20 companies)	B – 89% (24 companies)
Digital production planning and organisation	A – 9% (7 companies)	A – 24% (18 companies)
	B – 19% (5 companies)	B – 48% (13 companies)
Predictive e-maintenance	A – 9% (7 companies)	A – 24% (18 companies)
	B – 67% (18 companies)	B – 77% (21 companies)
Cloud computing	A – 9% (7 companies)	A – 16% (12 companies)
	B – 7% (2 companies)	B – 19% (5 companies)
e-business, e-communication with supplier or customer	A – 37% (28 companies)	A – 47% (35 companies)
	B – 74% (20 companies)	B – 70% (19 companies)
Industrial 3D-print technology	A – 7% (5 companies)	A – 16% (12 companies)
	B – 7% (2 companies)	B – 11% (3 companies)
Smart logistics	A – 7% (5 companies)	A – 12% (9 companies)
	B – 7% (2 companies)	B – 11% (3 companies)
Adaptive automation	A – 4% (3 companies)	A – 11% (9 companies)
	B – 0	B – 3% (1 company)

Industrial Internet of Things	A – 4% (3 companies)	A – 11% (9 companies)
	B - 0	B – 3% (1 company)

3. Question: Which real profits / feedback did you achieved in last year of Industry 4.0 implementation tools stage in according to combination with traditional industrial engineering methods?

Verified results showed, that most companies used new Industry 4.0 tools with the goal to improve the effects of traditional industrial engineering methods. From A-category 87% (69 companies) it sought to find more intelligent solutions for example in the area of flexible production planning and control, productive maintenance and reduction of SMED times directly by selected workplaces. A few companies had the goal to increase the number of e-processes from the area of production processes connected with selected supporting and administration processes – only 23% (17 A-companies). This fact corresponds with our knowledge from last 5 years, when we had map that the companies doesn't give the attention on the systematic structured changes in value added processes in triangle "technological changes – process changes – social changes". That was the reason, why we began strong orientation on the flexible man-man motivation performance management system for successful and effective implementation of key tools in Industry 4.0 concept.

Traditional man-machine system was oriented on the right combination of human management tools and machine availability dates in accurate time for realization of working tasks at the workplace (operator's generated information given to the machine as an input signal for starting of operation). When operator achieved information about failure, he should made some control procedures to identify by line the original of the failure. And here we can see fundamental difference between traditional production planning and organization and between from Industry 4.0 supported production planning and organization. Core component of this difference there is the man, which with strong cooperation with other key professional and experts plans, integrates and controls the flexible production and product plans in real time with substantial requirement – to program simultaneously adequate "correction answer of each equipment" in the failure case. As we can see, it is most important to give accent on the combination "man – man", because each e-technology realize only signals inputted from man as signals for process operations or steps. Each e-machine or other e-technology generates feedback electronically, this is based on the right given instruction in the software

program of each e-machine or e-technology from the man-man system.

## 4. METHODOLOGY

Basic pillar of functional production planning process in the philosophy Industry 4.0 concept is a knowledge of the key elements of the processes, by mutual interaction of these it leads to the creation of customer value added in the required time, quantity and quality. Accurate flexibility to respond in real time the customer needs is directly dependent on current disposable technology equipment, producing the desired output. There is necessary to set correct core and supporting processes, as well as flexible settings of selected production parameters affecting the productivity and efficiency of production. In our paper and based on realized survey we concentrate our attention on the element of man position in the Industry 4.0.

The reason why we have chosen directly this area lies in the fact, that it growths a number of daily communication man-man conflicts and inefficiencies by planning and organization of production operations. It is true that if we have more through computer and per man organized production processes, we have exponentially more conflicts between these employees. Our methodology will suggests the optimal settings of man-man system to achieve optimal profit from technologies, organized in Industry 4.0 production concept.

Industry 4.0 environment dispose with a high level of e-processes, automation and robotics – always we speak about technologies that operate on the basis of impulses, the man entered into the system. A prerequisite for correctly entering the instructions technological devices is right and effective communication among employees of different departments. These people influence flexible handling in real production daily life and daily situations. That is why we talk about "man – man" system, as an equally important part of complexly production process planning and organization together with the software / information systems support. The main characteristic of the system "man – man" is the ability of a worker to communicate effectively about the desired process inputs and outputs with other worker so that this communication will lead to the set of specific actions, which tends to set the production e-processes and e-technologies (in opposite to the machine technologies).

Every impulse that worker entered into the system is by nature unique and evokes absolutely accurately described

feedback, which is modeled in given software system of selected production technology by machine. It is likely that every impulse, given by the staff, aimed at using the specific functionality of the available technology. The group of multiple e-technologies included in the layout of the production line in a row represents a huge portion of the possible combinations and solutions. Just choose the most suitable for the productive production system and

meet the customer requirements are a task, which is supporting in the “man – man” system. Staff motivation for flexible production process is the willingness of an individual worker to realize complexly and productive activity. To manage flexible production system, we need right motivated staff, oriented on the readiness to realize operative and strategically process performances.

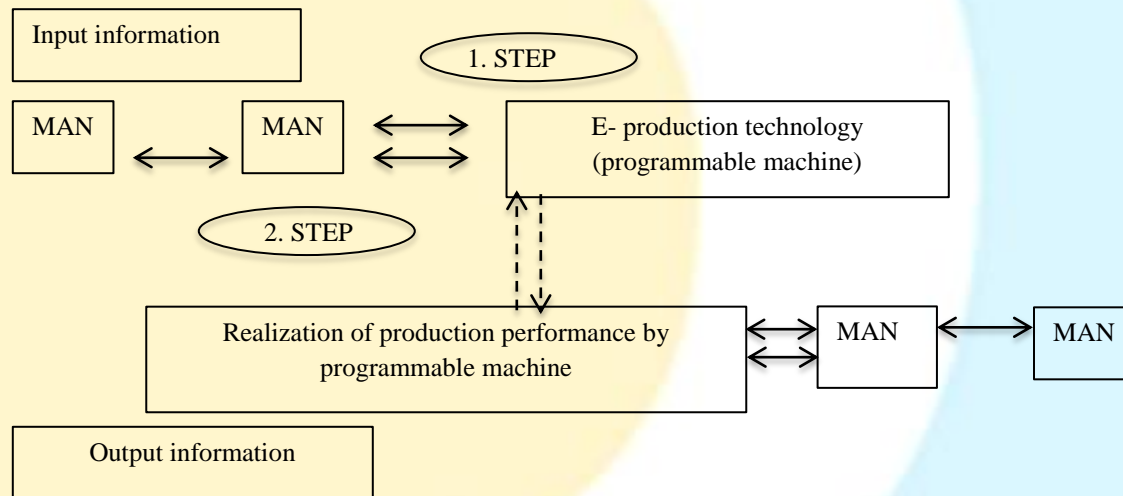


Figure 1: Core scheme of “man – man” system in Industry 4.0 concept (author’s source)

The proposed methodology of flexible “man – man” motivation performance management system for Industry 4.0 is based on the identification of the important motivation factors by workers, which have an essential connections for setting the adequate inputs for planning – realization – control of production process or production cycle:

- knowledge of stabile daily structure of production program and available production technologies (elimination of daily changes in production program and higher flexibility during weekly structuring of production program)
- certainties that the stocks intended for the production process are actually available (material, staff, information, standards, layout, material flow, etc.)
- setting of clear production and supporting processes for selected e-technology with regard to the allocation of responsibilities of specific staff (alternative for each shift individual responsible person with clear own e-code in information system)
- readiness of actual dates on daily basis for production planning in information system (motivated man has all necessary information available in right structured

information system, he don’t need manually or with big time wastes looking for all necessary dates)

- adequate working conditions by workplace for seamless realization of production planning and control (availability of databases, knowledge of performance and technological parameters by e-machines, standards for e-oriented production planning and control, software enabled flexible production planning and control in real time, feedback from unavailable machine capacity in information system just in time)
- proper allocation of competencies and responsibilities by staff linked in a process planning and control network
- possibility (competency) to influence selected parameters of e-technologies by customer requirements in real working day (in cooperation with IT-engineer)
- real feedback from workplaces about realized production losses in information system (realized production amount, re-work pieces, re-typing times, cycle times, maintenance times, etc.)

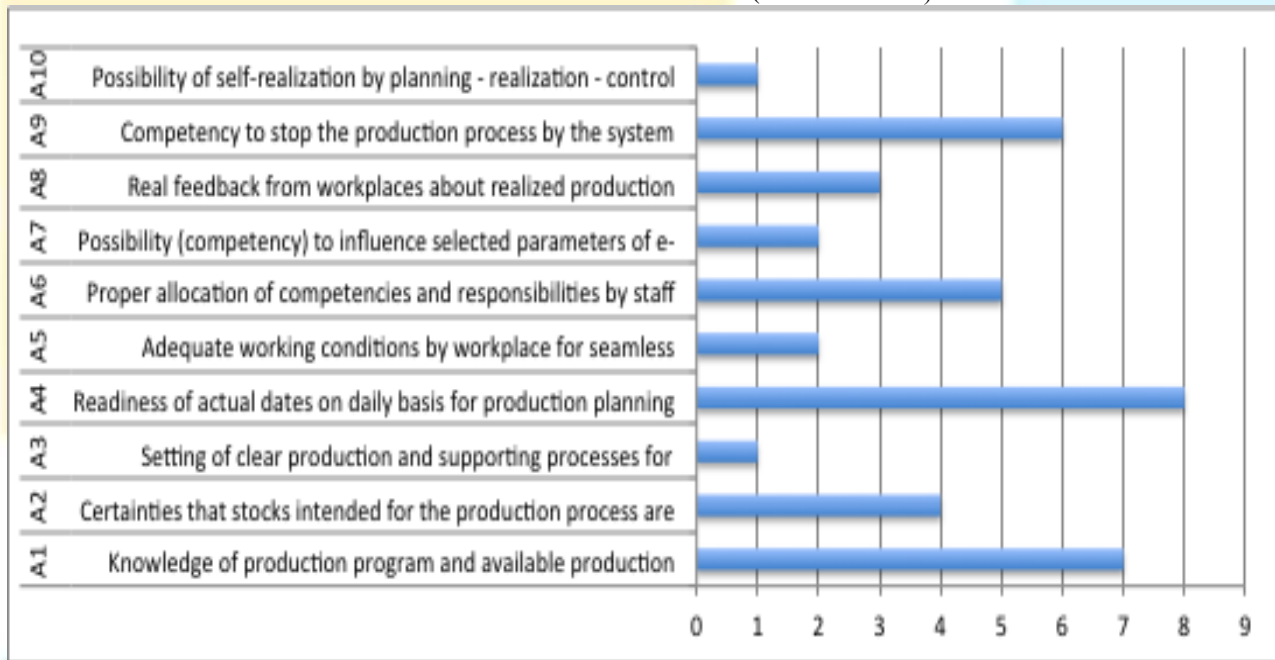
- competency to stop the production process by the system failure and active corrections in process management system as a preventive action
- possibility of self-realization by planning – realization – control of production system in according to balancing the performance management system and innovations given for higher profitability of this performance management system

All about mentioned factors are crucial for the “man – man” motivation towards achievement of flexible and productive performance management system in Industry 4.0 concept. There is most important to give know to each employees, what is his task, goal of his job and

responsibility for final result. Only based on these characteristics can each employee by specialized department communicate with each other employee with the goal optimal plan, manage and control the complexly e-production process.

Next we had identified the decision motivation matrix from these factors, which was tested in 75 companies used concept Industry 4.0. Respondents were process managers in each company, responsible for flexible realization of daily/weekly production program. Survey was realized in 34 automotive companies, 27 mechanical engineering companies, 7 chemical industry and 7 food industry companies.

Table 1: Decision motivation matric (author's source)



As we can see, 80% of respondents give important attention to the key parameter A4 – Readiness of actual dates on daily basis for production planning in information system. This parameter corresponds with the fact, that a lot of information's, given in the information system will be updated automatically based on customer order or real production process feedback, but a lot of information's should be modify or add by staff through effective communication between man-man from various enterprise departments. Daily occurs in production processes situations, when timely accurate intervention of responsible person affects the level of real just in time productivity and total performance. Good constructed motivation of staff and responsible level of mutual communication are than basic pillars of man-man flexible motivation performance management system.

Radical changes in data processing and network technologies in last times enabled access to data and information via e-processes. Higher motivation of man for flexible performance management system depends from knowledge and skills each person, integrated in the chain of complexly “man – man” production team.

## 5. RESULTS OVERVIEW

Based on results achieved in above-mentioned surveys we proposed a model of flexible man-man motivation performance management system available in environment of Industry 4.0 concept. Now we concentrate our attention on three core areas that are background of proposed motivation system:



**Process motivation factor** – its essence is setting and respect of standardized procedures in the area of production planning and organization information system from the input dates site and mutual man-man communication about real ongoing processes. By this type of people motivation there is necessary to set in close relation to the technological and software features of e-devices included in layout by Industry 4.0 concept. Following the results of the survey, the focus is centralized primarily on readiness of actual dates on daily basis for production planning. The required motivation can be achieved by properly formulated requirements for the operation of the process, its inputs and outputs. Effective process motivation by man-man system assumes the correct and straightforward electronic communication between the workers concerned by production planning and organization processes. The fundamental motivating factor is the existence of a standard for planning and management of priority orders and flexible re-planning of orders in the manufacturing process by daily basis without major complications for production planner and manager. Important part of process motivation factor there is the competency and possibility to make responsible decisions by actual problem solutions in real production times by e-machines and e-technologies.

**Product motivation factor** – design of flexible man-man motivation performance management system enables continuous improvement of the type of tasks implemented and continuously simplifying the realized tasks on the basis of existing information databases and e-technologies. A worker at a particular position is responsible for the task realized. At the same time, if it is necessary, he has the competence to change the selected parameters of the implemented tasks without to sparks a conflict with other in the complexly process integrated parameters. In man-man system there is important to have the possibility to integrate in the own processes small or radical process innovation in terms of added value through product. Motivated staff in man-man system is source of team innovations in the complexly e-processes environment, because they see the connections from more sites and can take correlated decisions in team.

**Personality motivation factor** – modern industrial technologies have a potential for radical development of staff qualification. Any used software has a possibility for continuous improvement of setting parameters. Without increasing staff professional qualification there isn't possible to realize changes in layout architecture and subsequent, mutual connected e-technologies. Similarly, as valid the option of rotation of workers in the manufacturing processes, can also be used in the man-

man system the option of skilling in the further “jobs” or “professions” that give the staff for better cooperation and teamwork and also the possibility of substitution of other staff. Considerable contribution for motivation is the fact, that based on knowledge of jobs realized in the production chain each person obtains the chance for innovations and improvement in whole processes and products.

Now it is important to construct simply formula for the definition of complexly motivation of man-man system. This formula should bring the clear rule for managers, how to evaluate actual motivation of staff connected with achieved productivity and profitability of their work in the production system and connected with the teamwork in the form of man-man system. For the purpose of development of flexible man-man motivation performance management system for Industry 4.0 we proposed the following motivation equation:

$$MMMF = X_{m_{proc}} + X_{m_{prod}} + X_{m_{pers}} \quad (MMMF = 1,0)$$

where:

MMMF - man-man motivation factor

$m_{proc}$  - process motivation level

$m_{prod}$  - product motivation level

$m_{pers}$  - personality motivation level

- 0,5 level of X - full completion of tasks integrated in man-man system, null level of changes or mutual personal/system conflicts (100% satisfaction)
- 0,4 level of X - completion of tasks in limit given by time, amount of transactions given to the e-process or system (80% satisfaction, 20% of small disruptions or conflicts, may be waiting on the system answer or delivery of right information from other worker integrated in man-man system)
- 0,3 level of X – average completion of tasks by given production plan (50% satisfaction, 50% registration of process conflicts – bad order specification, late order entry, prioritization of order in one hour, conflicts by persons or system settings)
- 0,2 level of X – small level of mutual information exchange between staff integrated in man-man system (20% jobs realized by plan, 80% of conflicts or absenteeism of right setting of e-connections in information systems and communication channels by machines)



0,1 level of X – incompatibility of man-man jobs, tasks in production planning and organization system, there isn't possible to give order on right way in the system

This equation was used as a basis for setting of flexible motivation performance man-man system for staff by departments of production planning and scheduling.

To achieve the flexibility and mutual combination in the teams and man-man systems connections, there was necessary to define the right level of flexibility, we used following division:

1) minimal motivation factor – low man-man motivation  
 $MMMF = 0,3 m_{proc} + 0,2 m_{prod} + 0,1 m_{pers}$   
 (MMMF = 0,6)

2) realistic motivation factor – average motivation  
 $MMMF = 0,5 m_{proc} + 0,3 m_{prod} + 0,2 m_{pers}$   
 (MMMF = 1,0)

3) growth motivation factor – optimistic motivation  
 $MMMF = 0,7 m_{proc} + 0,3 m_{prod} + 0,2 m_{pers}$   
 (MMMF = 1,2)

Minimal motivation factor show us, that it is necessary to make some changes in the e-information system and next in the standards of job descriptions for staff, operating with process operations or tasks. It brings the knowledge about potentials for improvement in the system area, where we now see some accidents, which prevent to realise the manufacturing processes without failures.

Growth motivation factor draws our attention on the fact, that the e-communication system between e-technology and man-man system fulfils fully specified production tasks – without substantial problems. But there is a risk of staff motivation stagnation in the case of long time production period. In this case it is necessary to realize preventive the qualification growth of the staff, which can than realise innovations or improvement's in strong cooperation with other participated departments and on such way to contribute to development of new processes or products.

Necessary condition for implementation of presented model is existence of man-man system structures between staff positions, integrated in complexly chain of production planning and organization system. Than we can set the motivation system by given criterions. To adjust the system it applies the basic principle: all tasks must be completed according to the requirements set in the system; in the system there are right instructions for each e-machine, integrated in the Industry 4.0 concept. By flexible motivation system is identified the total motivation factor level – it depends from the number of persons integrated in man-man system (minimum are 2 persons – total factor is 2, by 3 persons integrated in man-man system is 3, etc.). Optimal level of mutual factors combination for flexible motivation is given in the following table – example for 5 jobs integrated in the man-man system:

Table 2: Flexible motivation man-man performance system example (author's source)

	mproc	mprod	Mpers
Staff 1 Workplace 1	0,5	0,3	0,2
Staff 2 Workplace 2	0,5	0,3	0,2
Staff 3 Workplace 3	0,5	0,3	0,2
Staff 4 Workplace 4	0,5	0,3	0,2
Staff 5 Workplace 5	0,5	0,3	0,2
<b>Total</b>	<b>2,5</b>	<b>1,5</b>	<b>1</b>



Figure 2

In such case there isn't need to take further motivation requirements, all tasks and jobs will be completed just right on schedule (or production plan). They guarantee, that a motivating factor and scope for continuous improvement of products and innovation, growth of staff qualification are secured in man-man system are satisfied. Our goal is motivated man-man flexible performance management system, which enables to secure optimal communication between man-man system and e-technologies, integrated in the production system.

## 6. PRIMARY STUDIES ANALYSIS

Presented motivation system was tested in 7 industrial enterprises, which has a basic level of Industry 4.0 concept (basic integration of e-processes through selected information systems connected with the machine

technologies by workplaces). Firstly it was verified the accuracy of the e-standards for entering and processing of dates for continuous running of production operations by e-machines. Next was proven workflow between workers integrated in man-man system and realized small correction according to the correct setting of working performance by workers. Based on the experience was specified parameter of flexibility for staff motivation at 10% of total optimal value +/-, this is acceptable level for optimal performance management in man-man system which secure optimal and stabile process performance setting. Number 5 gave standardized number of man-man system position. Testing was realized over 5 months in each enterprise. Total achieved values are summarized in following table:

Table 3: Comparison of results achieved by man-man flexible motivation system (author's source)

	mproc	mprod	Mpers
Factory 1	2,5	1,5	1
Factory 2	2,1	1,6	1,3
Factory 3	2,7	1,4	0,9
Factory 4	1,9	1,7	1,4
Factory 5	2,3	1,3	1,4
Factory 6	2,5	1,4	1,1
Factory 7	2	1,3	1,7

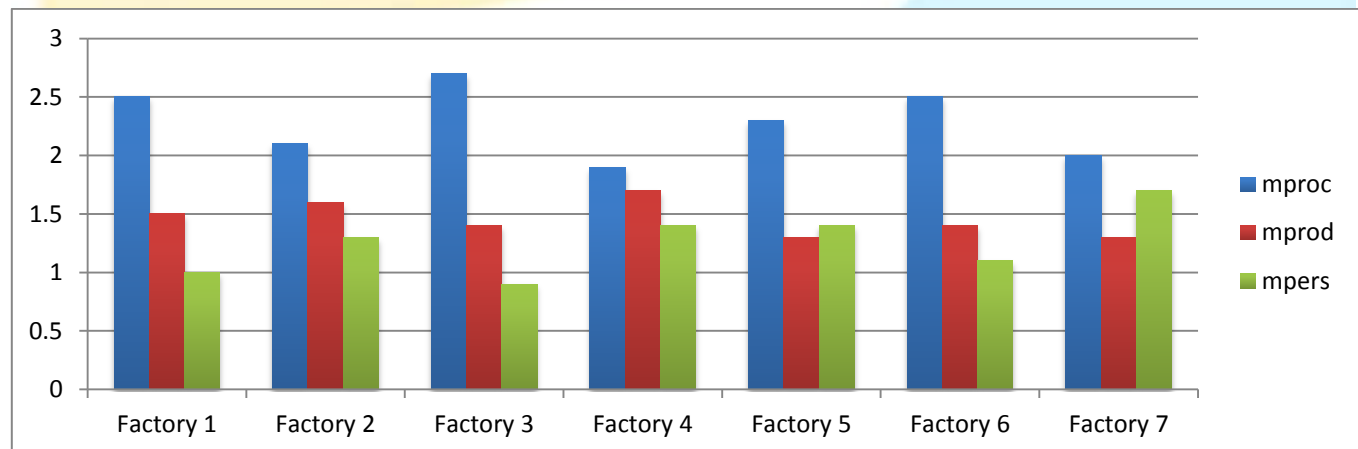


Figure 3

Results achieved by testing procedure were important for the balancing of the motivation performance system setting, the testing showed that enterprises should pay more attention to setting of processing parameters of used e-technologies, integrated in Industry 4.0 concept, this fact is crucial by the motivation of man-man system. Secondary was declared the right orientation of enterprise management in the product and personality performance

management motivation, because these two areas supporting the effective process management and guarantee the satisfaction of each person, integrated in man-man team.

## 7. DISCUSSION

The goal of this methodology is contribute to the better motivation of workers in industrial enterprises, using the

Industry 4.0 concept. At this time we are constantly confronted with the computer operations that influence substantially the oral communication between staff. There is still some minimizing of oral communication, which contributes to the fact that often increases the number of conflicts in e-processes. Industry 4.0 is a concept based on the electronic process control with minimum of human interventions in the setting processes. With our methodology proposal we can daily monitor the efficiency of realized man-man interventions and then take appropriate measures according to the higher satisfaction of our employees with the results of their work. Best motivation of each employee is the non-conflict working environment. Based on our methodology we can secure the compatibility between staff integrated in the man-man system and contribute to the development of profitable working teams by whole production chain integrated in Industry 4.0 concept. Flexibility by this methodology means the mutual cooperation between team members integrated in man-man system, each member have the chance to balance and to help other colleagues by problems solution or innovation proposals. There isn't substantial the power of individual person, but all members integrated in the man-man system as a team.

## 8. CONCLUSIONS

Strong orientation of industrial companies (RO Project Chromjakova, 2016) provides a drastic increase in demands on the motivation of production planning and organization staff by various departments in the e-technologies and e-processes environment. These are inevitable associated with the efficient manufacturing process and continuous flow manufacturing operations. Only when we will have right motivated personal, can we achieve optimal performance from Industry 4.0 concept. Future show us, that without adequate man-man system, as a core supporting element of production systems there isn't possible to develop effective information systems and technologies for new products and sophisticated technologies for customer with individual demands. Team creativity will be a background of each future production system, based on the Industry 4.0 concept. Next research and development in this area will give attention on the specialized production operations and their influence on the flexibility of man-man system (assembly operations, material or information flows by workplaces, maintenance, quality assurance, team work, intelligent automation etc.).

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