DIGITAL TECHNOLOGIES FOR PERSONNEL MANAGEMENT: IMPLICATIONS FOR OPEN INNOVATIONS

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ABSTRACT

Personnel management in the digital industry has become inextricably linked with open innovation, as a greater emphasis is placed on finding talents best suited for a specific company and on controlling the situation in the rapidly changing environment. In this context, it is important to bridge the current gap in the literature, understanding how introducing innovative approaches in personnel management allows to support simultaneous complex processes, finding the parameters required for performance assessment and forecasting. The goal of the article is to consider multiple options of personnel management metrics, outlining their strengths, weaknesses and opportunities, and present the suitable dashboard with the most appropriate indicators. We propose an innovative tool that can help managers at different levels to effectively handle diverse scenarios of personnel performance. We have formulated the criterion for choosing most appropriate innovative personnel management digital dashboard, investigating various metrics and KPI which should be chosen to assess the company's current situation in terms of personnel management. We present an example of the dashboard, which is a ready solution that can be adapted to the specific company environment. A detailed modification of the proposed digital dashboard for personnel management based on the fundamental approach to engineering incorporating open innovation could be a topic for a further research.

Keywords: Innovation, Personnel Management, Digital Dashboard

INTRODUCTION

In 2020, the world is facing unprecedented challenges. Organizations and people need to adopt solutions which were never used before or were only at the development stage. In the current climate, human resource management needs to be adaptive and innovative, taking advantages of digital technologies. There is a greater focus than ever on matching professionals with companies where they would thrive given their particular skillset. A study by the Boston Consulting Group emphasizes that the biggest challenge for the future is the lack of skilled workers to meet the demands of the digital economy. PWC's research concludes that in a digital environment, the key for people will be the ability to adapt to a changing environment and the ability to continuously acquire and apply new knowledge. Many companies with their own market research units, such as Deloitte, Ceridian, the financial and economic magazine Forbes, and the digital electronic publishing platform ISSUU, are tracking the development of human resource management practices.

Against this background, the open innovation paradigm becomes a powerful tool for exploring the nature of interactions within the entities comprising the digital industry ecosystem. The theoretical framework offered by the culture of open innovation implies that as collaborations evolve between and within entrepreneurial actors, shaping the local entrepreneurial environment, fundamentally new tools and methods are necessary to assess these processes and forecast their consequences.

In this study, we consider the innovations in personnel management based on digital technologies supporting multiple processes required for the specific needs of a company. We have considered the approaches outlined in (Bates, 2015; Manuti & Palma, 2018) as well as the HR 4.0 approach in (Gueutal, Stone & Salas, 2015; Liboni et al., 2019), measuring assets that are similar to any other company (Bondarouk & Brewster, 2016; Parry and Tyson, 2011). We focused on different metrics and KPI for personnel management, analysing their benefits and drawbacks. Ultimately, our goal consisted in developing an approach to innovations in personnel management based on a novel tool, the digital dashboard, which would allow to detect and measure the most appropriate and applicable indicators for the company. For this purpose, we formulated a criterion that could serve for selecting the most effective digital dashboard. A fundamental engineering approach based on open innovation could be used to perfect the proposed dashboard.

FUNDAMENTALS AND METHODOLOGY

Literature Review

Analysis identified a number of key trends apparent in digital personnel management. Starting from 2014, when people understood that world and processes will change significantly with the spread of digitalization, many new ways of working in different spheres were developed. This process involved innovative development of personnel management functions. Here we discuss the known methods used in the digital era applicable for personnel management.

1. Automation of communication with the candidate (chat bots, video interview, etc.) With the increase in use of technologies and trends for automation of processes across the company, personnel management also has adopted innovative ways of communication. However, current artificial intelligence technologies have limited utility, and can only provide responses within a narrow range of prescribed scenarios (Zehir, Karaboğa & Başar, 2020). Talking about personnel management and the hiring process in particular, the use of chat bots can potentially lose candidates, due to the complexity of process instead of that being a helpful tool (Nawaz & Gomes, 2020).

2. Automation of personnel management operations (ERP systems, ATC). These tools are very widely and commonly used for some time now. Here many indexes can be calculated, so the assessment of personnel

management can be easily done. There is no need to talk about the advantages of using these tools, but concentration on performance metrics, not taking into account emotional intellect is proven to be a very arguable method. The current generation needs to be managed with methods other than that used 20 years ago: millennials are concentrated on self-development and self-realization, which is unattainable for organizations purely using different cost indexes (Brant & Castro, 2019; Chillakuri & Mahanandia, 2018).

3. Automation of reporting (dashboards, benchmarks, etc.). This method has become very popular in the digital era and has multiple advantages such as: simplicity, visibility, accountability, comparison (Bril, Kalinina & Valebnikova, 2016; Buttner & Tullar, 2018). The only risk factor is creating too many dashboards for the end users (Krasnov et al., 2019a).

4. Automation of candidate search (search/evaluation systems for relay candidates on job sites, social networks, etc.) As artificial intelligence is demonstrating significant improvements, it has been used to prepare the profile candidates in such companies as Amazon, Google, IBM (Black & Esch, 2020). But the analysis conducted by the real person can be significantly different from that, prepared by machine. So here, the algorithm should be set-up in such a manner to include multiple options for analysis, which is an extremely manual task, so presumes a number of risks (Krasnov et al., 2019c).

5. Automation of employee development (recommendation systems (training careers, benefits, etc.)) Here, the discussion also about taking into account multiple options and decisions to be made by artificial intelligence (Nehles, Renkema, & Janssen, 2017; The HR World, 2017). Organizations will not be able also to provide individual solutions for every employee, so the development will be limited, while using human work in deciding which opportunities to provide can become more flexible (Barykin et al., 2020; Borisoglebskaya et al., 2019).

6. Automation of collaboration (organization of the environment, workplace, workflow, feedback services, etc.) collective brainstorming is an effective way to find non-standard solutions and with the help of technologies can unite specialists all over the world (Garaus et al., 2016; Malik, Froese & Sharma, 2020). The challenges here are how to account for the ideas, and how to develop the effective approach of working together, so that everyone stays motivated and attracted (Gardner, McGranahan & Wolf, 2011; Pilipenko et al., 2019).

7. Remote work (employees do not work in the office). The coronavirus crisis of 2020 showed to what extent organizations were ready for remote working worldwide (Brynjolfsson et al., 2020). The results of the crisis will definitely change the way of working for many companies. The questions to discuss here is how to manage working from home for the line and functional managers (George, Lakhani & Puranam, 2020). To effectively promote self-discipline, a very important thing is to develop human capital. Managing human capital can increase responsibility and motivation. Employees with a high level of human capital can easily overcome volatile situation both within their lives and within organizations.

8. Employee self-service tools (application automation, information systems) Automated systems to improve filling different forms have simplified several processes, but this simplification implies high level of attention to check the correctness of the information (Johnson, Lukaszewski & Stone, 2016; Krasnov et al., 2019).

9. Cloud technologies (placing data in the clouds) became an integral part of people lives. Personnel managers should be very confident in storing personal data secured, as data protection is imposing more and more restrictions every year (Ziebell et al., 2019).

10. Predictive analytics (forecast of efficiency/staff turnover, etc.) Classic tools are also used in digital personnel management, but the indicators for analysis have changed. Managers should not only understand how many people resigned, but also why they have done so (Parshukov, Bril, & Krolivetskaya, 2020). Revealing the gaps can potentially significantly improve the conditions within the company (Balaban, 2019; Provotorov, Sergeev & Part, 2019).

11. Wellbeing services. The new generations of employees assessing multiple factors when making the decision about the employer and the wellbeing services can make an additional benefit for the best talents (Liu, Cooper & Tarba, 2019; Salau et al., 2018; Victorova, Valebnikova & Valebnikova, 2019).

RESEARCH METHODOLOGY

Methodological Approach to Innovations in Personnel Management

The analysis we conducted helped to synthesize the literature and reveal the key ideas accumulated by scientists, economists, lawyers, and managers in this field. Approaches to strategic management, cyclic recurrence of economic systems' development in the context of investigation of features of effective strategic solutions, resource and business provision of

innovation management and education excellence through vision, their implementation are presented in numerous papers. For example, Christensen et al. (Christensen, Olesen & Kjær, 2005) address how the open innovation concept can be analyzed from an industrial dynamics perspective, considering the specific measures that different companies take to manage open innovation from the standpoint of their differential position within the innovation system in question, the nature and stage of maturity of the technological regime, and the particular value proposition pursued by companies focusing closely on the complex interplay between technology entrepreneurs and incumbents. A concept model of open innovation built up in (Yun, Kim & Yan, 2020) is intended for exploring the existing open innovation channels, and how these channels operate as a knowledge conduit that helps combat the growth limit of capitalism in the 4th industrial revolution.

Figure 1 shows a diagram summarizing the research methodology.
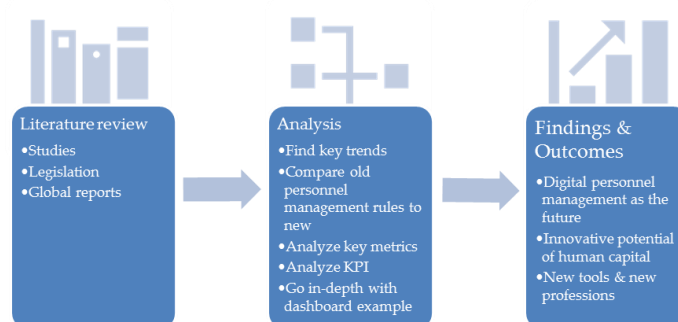

FIGURE 1
METHODOLOGY OF THE STUDY

The review of Russian and foreign literature, legislative documents, and global reports define the structure of our paper. For each component of the structure we analyzed:

- The logic of relationships between state, regional and corporate governance,
- The impact of digitalization on personnel management,
- The summarized results, and
- The prevalent research methods and paradigms in the extant literature.

Reviewing the relevant literature, global surveys and research studies is an integral part of all academic work as it forms the basis for new knowledge.

Dashboard Example – Personnel Management Metrics and Risks Associated with Them
When applying knowledge about the most suitable dashboard, Personnel managers should consider several factors:

- Deployability: detailed analysis should be possible, covering such issues as the reasons why the company is not meeting its recruiting goal, or groups are the most expensive to recruit.
- Simplicity: understandable KPIs to communicate and focus.
- Feasibility: The reason personnel management only focuses on KPIs related to personnel management results is because they can influence them. Personnel management is not responsible for revenue or sales success. Focus only on KPIs that you can influence the results of.
- Connectivity: The business goals, personnel KPIs should be linked to those business results. Potetially, the hiring costs can be reduced by 30% without compromising on quality. This is more important because it helps to implement the company's strategy. It is assumed that there should be a direct link from KPIs to goals, from goals to goals, and from goals to strategy.
- Consistency: Alignment of personnel KPIs is what we briefly considered earlier. Key performance indicators should not undermine each other.

Regarding this, we propose the following format of personnel management digital Dashboard (Figure 2):

Type	Risk Description	Status	Comparison*	Commentary
People	Absence Level (excluding contract staff)	G	CW=2.61% 1M=2.95% 3M=2.81%	Peak rates of 2 sickness, and 18 self isolating/shielding.
People	Critical Retain resignations	G	CW=1 PW=0	Three resignations are being reported this week, which occurred in previous reporting weeks.
Process	Mid-Year targets review completion	G	CW=2	2 departments still have not submitted the results.
Process	Mid-Year Promotion Ratio	G	CY=5% PY=8%	5 % of employees promoted during mid-year review. 80 out of Mid Grades, 1 % - top management, 9 % low level Grades
Process	Quality of Hiring	G	1M=0.90% 12M=1.83%	1 person resigned out of those hired for the last 6 months
Process	Training Rate	G	CW=10% 1M=15% 12M=15%	10% of employees attended internal/external learning sessions.
External	Phishing Attacks (users attempting access to >30 malicious URLs in a day/users attempting access in a week)	A	CW=1/51 1M=0.8/38.0 3M=2.1/36.3	51 users below the 30 attempts per day threshold (=amber [30-60]). 1 user above threshold (=green [<5]).
External	COVID-19 impact. Here organisation should fill the information applicable for the zones of presence.			
System	Change Request Failure	G	CW=0% 1M=2% 12M=4%	No failed CRs out of 18 implemented in August.

Risk Description	Number Resolved	Breached SLO	Major Incidents
IT Priority 1 Incidents	1 1 month average 1.50 12 month average 2.40	0 1 month average 0.75 12 month average 0.96	0 1 month average 0 12 month average 0

FIGURE 2
AN EXAMPLE OF PERSONNEL MANAGEMENT DIGITAL DASHBOARD INCLUDING RED-AMBER-GREEN STATUSES

This particular example shows how metrics can be divided between different sections, such as people, process, external and system. Each company should adopt the Dashboard and the metrics applicable for it. Knowing that there should be no more that 5-10 metrics presented at one go, the Dashboards can be created for different purposes:

• One presented to the stakeholders on a weekly basis to outline the current state and tasks faced by personnel management functions;
• One presented monthly, where project results can be outlined, and the overview of the monthly situation is done;
• One presented on a quarterly basis to show the progress of different tasks and projects and to accumulate the results within longer period of time;
• Mid-year dashboard can help to align strategic goals with current project and coordinate work for the following periods;
• Yearly presentation will most probably include lots of different metrics and wide review of everything that has been done during the year, also outlining plans for the next year in terms of implementation of personnel management tools and metrics.

Theoretical Fundamentals of Innovations in Personnel Management Metrics Based on Digital Dashboard

Metrics in Personnel Management Report

There are several important metrics that need to be included in a personnel management report based on the digital dashboard. The most common personnel management metrics include (Bril, Kalinina & Ilin, 2017; Collings, Mellahi & Cascio, 2017; Nocker & Sena, 2019):

• Seniority.
• Sex.
• Age.
• Education level (Cafferkey et al., 2019; Khan & Tang, 2016).
• Function type.

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• A Full-Time Equivalent is the hours worked by one employee on a full-time basis (Zubielqui, Fryges & Jones, 2019; Gothelf, 2017). People who work less than 1 FTE can be considered part-time workers (Johnson & Scholes, 1997).
• Employees Active.
• Turnover.
• New hires.
• Absence (Heuvel & Bondarouk, 2017).
• Cost of absence (Garavan et al., 2016).
• Cost of labor.
• Training cost (Schislyaeva et al., 2019).
• Recruitment cost.
• Time to fill.

Other metrics that can be included, moreover, it is important to consider how to create KPIs out of those metrics.

Key Performance Indicators (KPIs)

Personnel management KPIs are metrics used to assess the contribution of personnel to an organization.
Let us consider several KPI examples:
• Absenteeism: An organization's absenteeism rate is usually calculated by dividing the number of work days an employee was absent by the total number of work days (Strenitzerová & Achimský, 2019; Torosyan et al., 2020).
• Cost of absence: The total cost of absence is calculated by including the employee's remuneration, the cost of managing the absence, and the cost of replacement. This KPI is especially relevant for European countries with strong trade unions and a high degree of worker protection (Valebnikova, Valebnikova & Kalinina, 2019).
• Satisfaction with benefits: Satisfaction with employment benefits is usually measured using employee engagement surveys. Metrics can be very relevant to reduce employee turnover.
• Employee productivity level: While this indicator is difficult to calculate, it says something about the ability to grow in terms of human capital production (Borisoglebskaya et al., 2019a; Borisoglebskaya, Provotorova & Sergeev, 2019b).
• Employee Satisfaction Index: Employee satisfaction is measured through a survey of employee attitudes and engagement. Dissatisfaction is an important cause of employee turnover (Metcalfe, 2019; Podgorodnichenko, Edgar & McAndrew, 2020).
• Employee Engagement Index: Employee engagement is also measured through an attitude or engagement survey. High employee engagement predicts higher productivity, better customer service, lower employee turnover, and many other important and positive results (Aust, Matthews & Muller-Camen, 2020).
• Employee Innovation Index: Innovation is also measured through attitudes or engagement surveys. Innovation is increasingly becoming a key factor in business success. The role of personnel management is to support this innovation (Chowhan, 2016).
• Internal Promotion Ratio: This KPI is measured by dividing the number of promotions that were filled through internal promotions by the total number of filled positions at that level. With internal advancement, employees gain insight faster, reduce the risk of poor recruitment, and stay with the organization longer (Novikov et al., 2019).
• Customer Loyalty Score: The Customer Loyalty Score (NPS) is a great way to measure the extent to which someone will recommend a service or business to another person. To find out how satisfied employees are with personnel management services, you can measure HR NPS. NPS can also measure the extent to which people recommend working in an organization. Depending on your strategic goals, NPS can be a reliable personnel KPI.
• Percentage of personnel costs: This is a metric that divides the cost of personnel costs by the total costs incurred by the organization. This KPI, although not often used, can be used for cost reduction purposes or to improve automation/robotization in an organization.
• Quality of Hiring: Quality of Hiring is the percentage of new hires who receive a good rating from their manager during the performance analysis. The quality of hiring shows how effective personnel management is in recruiting and selecting candidates. Continuous maintenance of quality at a high level allows the organization to achieve its strategic goals.

• Fluidity: Fluidity is a very common metric and also an important KPI, since a high metric can be very expensive (Raffiee & Byun, 2020).
• Employer-initiated dismissal: Not all turnover is voluntary. This is the number of dismissals initiated by the employer as a percentage of the total number of dismissals.
• Employee-initiated terminations: This is the number of voluntary redundancies of employees as a percentage of total redundancies.
• Unwanted layoffs: not all turnover is bad. When bad performers leave, it's good. The indicator is the number of good performers who quit as a percentage of all performers.
• Effectiveness of training: Training must be effective to achieve its goal (s).
• 90-day termination rate: Sometimes also 360-day rate. This is the number of employees who leave within 3 months or a year. The double-digit percentage is already very bad. HR's job is to recruit the right people. Failure to do so will have a measurable negative impact on organizational performance. This is a key selection KPI

RESULTS

Evolution of Personnel Management Rules Based on Digital Technologies

Thus, with the evolution of digital technologies, risks associated with them are also evolving. It is crucial for companies to assess not only the possibility of implementing something, but also how this would be perceived by the people working inside. As they are forming the most valuable source – human capital for further development and prosperity.

The rules in personnel management have significantly changed over the last 4–5 years. The summary of these changes is presented in the Table below.

Table 1 SUMMARY OF THE OLD AND THE NEW PERSONNEL MANAGEMENT RULES	
Old Personnel Management Rules	**New Personnel Management Rules**
Focus on designing and streamlining the process to create standard HR methods	Focus on optimizing employee performance, engagement, teamwork and career development
A cloud provider and implements non-standard practices	Innovative programs, applications and strengthen the platform for further development
Personnel management programs are designed for scale and consistency	Personnel management programs are developed for various segments of employees, providing at the output a map of the development of their career and profession
Personnel management focuses on "self-service" as a way of measuring service and support	Personnel management focus is on opportunities, this function wants to help people do their jobs more efficiently
Personnel management creates a "self-service portal" for employees - a technological platform that allows you to quickly find the information you need	Leveraging digital capabilities, personnel management creates an integrated platform based on employee experience

To track the changes that evolve in global personnel management metrics and those implemented within the company, it is crucial to have adequate personnel management metrics in place. There is a huge number of indicators, that can be used over the personnel management report presented on a weekly/monthly basis (Bamber, Bartram, and Stanton, 2017). The question is how chose the most applicable ones and interrelate them between each other. In this article we will try to distinguish the characteristics of the most valuable metrics for personnel management report.

Innovation in Personnel Management Assessment Based on Digital Technologies

Algorithmic Foundations of the Model for Assessing Personnel Management

Along with specifics of a particular company, personnel management has certain universal aspects. This is the problem of recruiting and retaining personnel in a competitive business environment. The structure of personnel is also important for controlling the situation in a changing market environment.

It is important to find adequate approaches to solving this problem because the key factors providing competitive advantages are the balance of costs for personnel search, employee loyalty, work comfort, promotion prospects, and the company's reputation.

Choosing a method that can best serve as an innovative digital algorithm for assessing personnel management operation, we have focused on the methodology for assessing loyalty, formulated by Deming and Glasser.

Employees are grouped into categories by duration of employment contract. These quantities serve as elements of the vector, $\overline{C} = \{c_1, c_2, ..., c_n\}$ (where n is the number of gradations), reflecting the personnel structure of the enterprise. Next, based on statistical data or expert assessments, the probabilities of transitions between categories are assigned, which are compiled into a right stochastic matrix $P = \{p_{ij}\}$ for i,j=1,..,n, so that the following condition is met: $\sum_j p_{ij} = 1, \quad \forall i$.

This matrix is called the personnel management partnership matrix. Next, an equation is formulated for determining the parameters of the trend for the change in the vector $\overline{C}_1$ of personnel (by category) in a year:

$$\overline{C}_1 = \overline{C} * P + \overline{C}_K$$

where $\overline{C}_K$ characterizes the actions of managers searching for applicants for existing positions; it is expressed numerically by the rate at which new employees appear. Similarly, the following expression is obtained after 2 years:

$$\overline{C}_2 = \overline{C}_1 * P + \overline{C}_K = \overline{C} * P^2 + \overline{C}_K * P + \overline{C}_K$$

As evident from the obtained expression, if the planning horizon for the personnel service is expanded by M periods, there is a progression in powers of the matrix P:

$$\overline{C}_M = \overline{C} * P^M + \sum_{q=0}^{M-1} \overline{C}_K * P^q$$

The Result of the Proposed Model in Personnel Management Assessment

The given technique can be illustrated by a simple example, where only four aggregated gradations of personnel composition of the enterprise appear, summarized in Table 1, where the columns correspond to the elements of the vector. Notably, if necessary, this list can be expanded within arbitrary limits, but the principle remains the same.

Table 2 GRADATIONS OF CATEGORIES OF PERSONNEL BY DURATION OF EMPLOYMENT CONTRACT			
Duration of Employment			
c_1	c_2	c_3	c_4
Employed at the company for less than a year	Employed at the company for 1–2 years	Employed at the company for more than 2 years	Resigned

Next, a matrix of personnel partnership P is composed; its elements are summarized in Table 2. These values are statistical estimates of the probability of transitions p_{ij} between the given categories $i,j=1,..,4$, which make up the complete group of events.

Table 2 ASSESSMENT OF INTEREST IN BUSINESS INTERACTION WITH THE UNIVERSITY	
Personnel management interaction category	Statistical or expert assessment for probability of transition for duration of employment
employed at the company for less than a year	probability that the employee stays for 1–2 years=p_{12}
	probability that the employee resigns=p_{14}
employed at the company for 1–2 years	probability that the employee stays for > 2 years=p_{23}
	probability that the employee resigns=p_{24}
employed at the company for more than 2 years	probability that the employee stays=p_{33}
	probability that the employee resigns=p_{34}

For the calculation with specific numerical values, the example used the data reflecting the statistics of the enterprise's interaction with employees over a 3-year period. All the data provided were obtained by processing the information about contractual relations (aggregation by years, the percentage of prolonged, renewed and terminated employment contracts, as well as the number of new employees). Next, a matrix of the level of personnel partnership is composed

$$P = \begin{vmatrix} 0 & 0.75 & 0 & 0.25 \\ 0 & 0 & 0.83 & 0.17 \\ 0 & 0 & 0.9 & 0.1 \\ 0 & 0 & 0 & 1 \end{vmatrix} \text{ along with the current vector } \overline{C} = \{120,180,230,0\}$$

Thus, the distribution of the staff is recorded for the current date.

A fragment of the algorithm for calculating the quantitative indicators of changes in the personnel by duration of employment in accordance with the proposed technique is shown in Table 3.

Table 3 PERSONNEL PARTNERSHIP MATRIX				
0	0.75	0	0.25	
0	0	0.83	0.17	
0	0	0.9	0.1	
0	0	0	1	
Current Vector of Personnel Structure				
Less than a year	1–2 years	More than 2 years	Resigned	Sum

120	180	230	0	530
Hiring New Employees				
Personnel performance				
120	0	0	0	

Next, the calculation shows the dynamics of changes in the personnel depending on the duration of employment.

Table 4 VECTOR OF PERSONNEL STRUCTURE 1 AND 2 YEARS LATER			
Vector of Personnel Structure in a Year			
120	90	356.4	83.6
Vector of Personnel Structure 2 Years Later			
120	90	395.46	164.54

To summarize, this technique yields the degree of employee loyalty and the level of mutual interest of the employer and employee. At the same time, the calculations should take into account the balance of the costs of finding suitable candidates as well as the costs of incentives necessary to motivate employees to continue working in the enterprise.

DISCUSSION

Digital Technologies in Personnel Management and Implications for Open Innovation Concept

Role of Digital Technologies in Personnel Management

Personnel management reports on the basis of personnel management digital dashboard as an innovation keep managers informed of relevant developments in their team and department. For example, when a marketing department is struggling with high turnover and long hiring times, it is likely that executives should focus on retaining employees, educating them about the risks of taking longer to replace those laid off (Pulyaeva et al., 2019).

According to Dawn Cacciotti, founder of EngageHRnow®, human resources strategist, and contributor/co-author of Cultivating Culture, "HR has a profound ability to impact the results of an organization and the use of HR dashboards is essential for assisting organizations to accomplish their strategic plan. When well-designed, HR dashboards mirror the needs and pathways set by the strategic plan. They can also pinpoint a particular area within the organization that is either negatively impacting their growth or can focus on an area that the strategic plan showcases as the main area of future growth" (Cacciotti, 2016).
The detailed modification of the proposed digital dashboard for personnel management on the basis of open innovation engineering fundamental approach could be a topic for a further research. Additionally, the approach of Christensen's determinants of the open innovation model (Christensen et al., 2005) should be taken into account. His approach is associated with the industrial dynamics of an industry segment undergoing a process of radical technological innovation and unravels the Chesbrough's Open Innovation concept which was initially studied by from the company-level perspective (in contrary to the closed innovation old model). The fundamental theory was created by JinHyo Joseph Yun considering the open

innovation engineering model including both open-innovation engineering channels and determining ways of operating the channels through conceptual experiments (Yun et al., 2020).

Implications for the Open Innovation Concept

The very foundations of the open innovation concept lie in the collaborations within entrepreneurial ecosystems. In particular, the open innovation paradigm could be applied for analysis of collaborations among stakeholders within an entrepreneurial ecosystem, supporting the integrative function of a business accelerator. Treating open innovation as the theoretical framework for collaborative innovation, we can regard collaboration as as the main distinctive trait of digital ecosystems. We believe that employing novel digital technologies for personnel management could improve the working environment of an enterprise, with open innovation mechanisms employed to regulate the processes and performance of actors within the entrepreneurial ecosystem. The open innovation culture encompasses the emergence of collaboration among entrepreneurial actors, organizations, and institutions, which employ different forms of interaction to regulate the performance within the local entrepreneurial context.

It is important to consider innovative teams as a unit for introducing solutions based on digital technologies. Our hypothesis is that introducing fundamentally new tools of personnel management; heavy emphasis should be placed on mentoring, networking, and educational programs for employees. The underlying theory we have developed is that the potential efficiency of a team within an enterprise depends on both the transparency of communications and the metrics imposed to assess the performance. We devised algorithmic foundations for the tools used to assess the corresponding components, in relation to the variation in the performance of specific employees and the overall personnel structure over time. A special technique was created for implementation and parametric interpretation of the results obtained using each tool. The calculated approach allows to exclude the subjective or emotional factors typically present in expert estimates: the assessment process becomes completely automated, which is perfectly aligned with the goal-setting of digital ecosystems in the open innovation paradigm.

CONCLUSIONS

Innovations in personnel management based on digital technologies allow reaching three key benefits for both personnel and management, of monitoring, informing management, and tracking problem areas.

When it comes to monitoring the progress and results achieved by employees, regular reporting enables personnel management to keep their finger on the pulse of the organization by tracking key workforce-related metrics. New trends and opportunities can be identified at an early stage, and the emergence of problems is identified and resolved before these problems have a significant impact on the business. Personnel management reporting can help managers do their jobs better, providing managers with up-to-date information in real time.

Human Capital is defined as the knowledge that each individual possesses and generates should be considered as a potential source of innovation and an immense importance in the development and economic growth.

Thus, personnel management digital dashboard corresponds to every capacity, knowledge, abilities and individual experiences of the employees and managers of the organization.

Personnel management reporting based on digital dashboard offers a good way to monitor key problem areas in a transparent manner. Transparency in turnover rates by managers will encourage them to pay close attention to staff retention, as their own reputation is at stake. By tracking problem areas, personnel management digital dashboard can strengthen its position in the improvement/change management path. In connection to the above, it is very important to present information in a high-quality structured way. Innovations in personnel management can provide a clear way to communicate personnel management data in a meaningful way. Creating a good dashboard will help Personnel management to specify and outline problems, thus find solutions to them, invest in human capital and promote consistency with other strategies and policies within the company.

The Council for Professional Qualifications in Personnel Management of the Russian Federation has compiled a list of new and promising professions in demand on the labor market, which includes non-widespread professions: coach, crisis manager, specialist in working with a database of organizations, specialist in electronic document management.

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CONFLICT OF INTEREST

The authors confirm that there is no conflict of interests to declare for this publication.

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