Proposal of an unconventional method to assess polyvalence in lean organisations

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Abstract: Lean management is considered as one of the mail challenges that organizations have to face to decrease their production costs and increase their performances. In this context, employees have been recognized as the real value added for a lean organization and the management of human resources a critical variable. In particular, the concept of polyvalence has been identified as one of the main pillars in developing lean initiatives. However, when a polyvalence program is established only a technical point of view is taken, neglecting soft skills perspective. To overcome this lack, this paper proposes a new approach on polyvalence evaluation based upon an unconventional model that considers both soft and hard skills. An empirical application shows that the expansion of employees' work allows improving the efficiency and the effectiveness of an organization, as well as the quality of employees' management as well as to enable suitable training and incentive policies.

Keywords: Lean organization, polyvalence, Human Resources management, soft and hard skills

1. Introduction

Lean management has been recognised as one of the most effective ways to improve operational performances along different perspectives (Belekoukias et al., 2014). However, lean organisations differ from organisations doing lean things, because of their orientation to focus on people instead of results (Mann, 2014). Indeed, the intellectual capital is the main resource to successfully face market competition and employees are the real value added of a company (Stewart, 1997).

Successful stories of lean management implementation underline that the application of lean principles and tools entails a simultaneous strive for lean mind (Liker, 2004). In particular, "learning lean manufacturing requires that there be training in both soft and hard skills in order to solve problems in both the social/cultural and technical aspects of production" (Badurdeen et al., 2010, p. 467). Nevertheless, even though social and interpersonal competences are considered fundamental for the success of lean management initiatives, existing practical training programs are mainly focused on hard skills, while the soft skills are often treated perfunctorily (Chan, 2015; Oladiran et al. 2011).

In order to overcome this gap, this study proposes an unconventional model for manufacturing companies, called Bow-Tie model that connects hard and soft skills. The model aims at providing the base for the definition of an easy method supporting manufacturing companies in evaluating employees' performances and therefore identifying suitable actions to enhance a proper balance between hard and soft skills. In particular, the method is applied to assess two new indicators that extend the traditional concept of polyvalence matching technical and relational skills perspectives.

After a brief description of the research design and methodology, section 3 introduces a literature review on the concept of human competences and on hard and soft skills. The description of the proposed model is presented in section 4, while the polyvalence assessing method is shown in section 5. Reliability and validity of the adopted approach are then identified and discussed in section 6, where the implementation of the method in a manufacturing company is presented. Finally, conclusions, limitations and further developments are reported in the last section.

2. Research design and methodology

This paper encompasses a deductive four-step 'top-down' analysis (Trochim & Donnelly, 2006). The first step includes a literature review followed by the development of a theoretical model, performed by a research team with Human Resources managers and production supervisors of a manufacturing company. The model is then adopted to develop a new method to assess polyvalence in lean organizations and further applied in a real context, where hypotheses are verified, results are analysed and the theoretical method is enhanced (Trochim & Donnelly, 2006).

3. Literature Review

Several models in literature consider human competences as crucial elements for business development (Hsieh et al., 2012). They usually take two main perspectives. The first focuses on employees' technical abilities (hard skills), namely the way they perform their work producing the right quantity of products on the established time (Hamel and Prahalad, 1994). The second perspective shifts the attention on transversal (soft) skills. Here, what becomes important is the inclination of individuals to intellectual, managerial and social abilities (Kamin, 2013).

3.1 Human competences

The word 'competences' is related to a set of inherent features of an individual, that are casually linked to a performance (Spencer and Spencer, 1993).

McClelland (1973) was the first researcher who distinguished between threshold and differentiation competences. The former are essential and necessary to effectively perform a job, while differentiation competences can make the difference between an excellent and a normal performance (Hay Group, 2003). Such competences derive from the individuals' behaviour and are correlated to working success (McClelland., 1973).

Spencer and Spencer (1993), who deeply investigated the importance of personal and intrinsic aspects correlated to motivation and private traits, formulated a more operationalized concept of competence. Adopting the metaphor of the iceberg the authors distinguished between (skills knowledge) observable and and hidden characteristics (self-image, traits and motives). In particular, according to Boyatzis' (1982), intrinsic skills are drivers for excellent performances. Moreover, an individual can be represented by his/her ability to deal with the environment where he/she operates. In addition, competences require the ability to combine and manage different resources in an intelligent way, in response to a given context (Boterf, 1995). Here, the importance shifts from resources and knowledge to the ability of people to analyse, plan, take relevant decisions and carry out effective solutions, proactively and independently (Leplat, 1990).

3.2 Hard and soft skills

Soft skills refer to professional individual qualities in terms of knowledge, abilities and personal attitudes. They describe a set of abilities that are not related to a specific activity or position, but to professional behaviours. Moreover, their high degree of transferability in any business organization make them considered the real value added for a business success (Manpower Group, 2014). Whereas soft skills are taken into account especially in roles with little remarkable specialization, the attention shifts to technical skills in contexts where wide technologies and production skills that empower individual businesses to adapt to changing opportunities, are needed (Hamel and Prahalad, 1994).

The goal is to achieve a suitable "fit" between the organization, i.e hard skills, and its environment, i.e. soft skills (Nonaka and Johansson, 1985) because "to implement

project successfully, it is necessary to combine both hard and soft skills" (Söderlund and Maylor, 2012).

4. Theoretical model design



As depicted in figure 1, the theoretical model, called Bow-Tie model, is made-up by five tasks (T), categorised into three different sections: the left-hand side section introduces hard skills to ensure quality and productivity, while the right-hand side section is dedicated to soft skills that have to promote proactivity and organizational commitment. Finally, the central section, that connects the two sections, reports the transfer of knowledge, namely a mix of hard and soft skills.

The identified tasks can be used to evaluate the polyvalence characteristics of an employee. In particular, an employee is considered polyvalent if he/she accomplishes all the five tasks in more than one workstation. A detailed description of each task is reported in the following:

- 1. **Promote proactivity (task T₁).** Proactivity differentiates self-regulatory and self-reflecting people from those who are moved by inner forces or by the environment. In the Bow-Tie model, the concept of being proactive is related to the capability of implementing simple actions in day-to-day activities, independently (Bateman and Creant, 1999).
- 2. Promote organizational commitment (task T_2). Organizational commitment is the employees' attitude to be loyal to the organization and to believe in its goals and ethics (Luthans, 2011), achieving company goal instead of their personal interest. In the application of the Bow-Tie model, it is essential that employees perceive such a culture, believe on it and promote the organizational commitment.
- 3. Ensure quality (task T₃). According to Total Quality Management philosophy, ensuring quality means that an operator has to possess the concepts and the techniques for a good quality control (Rajendra et al., 2013), detecting and correcting some work deviations, stopping nonconformity at the earlier stage of the process and thus improving quality.
- 4. Ensure productivity (task T_4). Ensuring productivity means that an employee has to produce the right quantity of products in a predetermined time using the right quantity of available resources. This process requires eliminating all unnecessary

distractions, reducing the downtime and organizing the work properly.

5. Transfer of knowledge (task T_5). This task represents the connection between hard and soft skills, and refers to teaching and training capabilities as well as communication abilities necessary to transfer both technical competences to other operators.

5. Polyvalence assessing method development

According to figure 2, a four-step method was developed to support managers in enhancing soft and hard skills through the assessment of employees' polyvalence.



Figure 2: Polyvalence assessing method - main steps

5.1 Step 1: List of roles definition

First of all, a list of potential roles characterising a production process was identified. Then, a job description including soft and hard skills required to fulfil the purpose of each role (R_i) was redacted.

5.2 Step 2: Degree for Role (DfR) calculation

In most manufacturing companies, different roles usually require different levels of knowledge, responsibility, risk attitude and/or strength. In order to capture such differences a DfR indicator for each role was created. In particular, for each role (R_i), the DfR_i can be calculated as the average value of five variables (V_1 : required experience, V_2 : availability of resources, V_3 : physical efforts, V_4 : mental efforts and V_5 : degree of responsibility). The evaluation of each variable that refers to a specific role (V_{ij}) ranges from 0 to 1 and is assigned by the production supervisors. Formula (1) shows how the DfR was calculated, while Table 1 reports the DfR table.

$\sum_{i=1}^{R} V_{ii}$
$DfR_j = \frac{-1}{5}$
5
Formula 1: Degree of Role (DfR) calculation

	<i>V</i> ₁	V_2	V_3	V_4	V_5	DfR	
R_1	V ₁₁	V ₁₂	V ₁₃	V ₁₄	V15	$D_f R_1$	
R_2	V_{21}	V ₂₂	V ₂₃	V ₂₄	V ₂₅	$D_f R_2$	
R_3	V31	V32	V33	V34	V35	DfR3	
R_j	R _{j1}	R _{j2}	R _{j3}	R _{j4}	R _{j5}	$D_f R_j$	

Table 1: DfR table

5.3 Step 3: Bow-Tie table (BTt) construction

A Bow-Tie table (BTt), reporting on columns the list of employees (E), and on rows all the identified roles (R), has been created to support the evaluation of each employee in relation to the five identified tasks ($T_1, ..., T_5$). In particular, as shown in Table 2, for each employee (E_i) and role (R_i), the table can be filled in, assigning a numerical evaluation (W_{ijk}) for each task T_k. To consider the extent with which the task is performed by each employee, an Assessment Ladder (AL), composed of four standard levels (0.08 = Sufficient, 0.12 = Good, 0.16 = Very good and 0.20 = Excellent) has been adopted. In case of an employee receives an Excellent evaluation in all the five tasks he/she would achieved a total evaluation of 1 (0.20 * 5).

Table 2: Bow-Tie table (I	BTt)
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	List of Employees (E)							
		E_1	E_2		E_i			
	T_1	W ₁₁₁	W ₂₁₁		W _{i11}			
R_{lj}	T_2	W ₁₁₂	W ₂₁₂		W _{i12}			
le (T_3	W113	W ₂₁₃		Wi13			
Ro	T_4	W ₁₁₄	W ₂₁₄		W_{i14}			
r	T_5	W115	W ₂₁₅		W_{i15}			
(T_1	W ₁₂₁	W ₂₂₁		W _{i21}			
R_{2}	T_2	W ₁₂₂	W ₂₂₂		W _{i22}			
le (T_3	W ₁₂₃	W ₂₂₃		Wi23			
Ro	T_4	W ₁₂₄	W ₂₂₄		W _{i24}			
,	T_5	W ₁₂₅	W ₂₂₅		W _{i25}			
•	T_1	W_{1j1}	W_{2j1}		W_{ij1}			
R_{ij}	T_2	W _{1j2}	W_{2j2}		W _{ij2}			
Role (T_3	W_{1j3}	W_{2j3}		W _{ij3}			
	T_4	W_{1j4}	W _{2j4}		W _{ij4}			
	$\overline{T_5}$	W _{1j5}	W _{2j5}		W _{ij5}			

5.4 Step 4: Degree of polyvalence (DoP) calculation

The application of the method can be used to produce two polyvalence indicators, associated to a standard and a weighted Degree of Polyvalence (DoP), briefly described in the following. In general, according to formula (2) and formula (3) the DfR_{ij} is assessed only if all the related tasks receive an evaluation at least sufficient ($W_{ijk} \neq 0$).

As reported in formula (2), the Standard Degree of Polyvalence of each employee $(SDoP_i)$ is calculated independently from W_{ijk} which represents how the single task is performed.

$$SDoP_i = \sum_{j=1}^{R} DfR_{ij} \prod_{k=1}^{T} \alpha_{ijk}$$

Formula 2: SDoP calculation

Where: R = number of rolesT = number of tasks

 $\begin{cases} \alpha_{ijk} = 0 \ if \ W_{ijk} = 0 \\ \alpha_{ijk} = 1 \ if \ W_{ijk} \neq 0 \end{cases}$

On the contrary, the Weighted Degree of Polyvalence of each employee $(WDoP_i)$ considers to what extent an employee performs his / her task, as reported in formula (3).

$$WDoP_{i} = \sum_{j=1}^{R} DfR_{ij} (\sum_{k=1}^{T} W_{ijk} \prod_{k=1}^{T} \alpha_{ijk})$$

Formula 3: WDoP calculation

6. Method application and discussion

This section describes a real application of the proposed method for polyvalence assessment. The selected company, named Alpha, produces, assembles and tests complex systems of led display. Alpha's employees have to produce, assemble and test most of the final product components. Moreover, some activities may require similar skills. In such a scenario, Alpha decided to apply the proposed method with the purpose of managing its production and facilitating the development of polyvalence among the whole organisation.

6.1 Method implementation

According to the method, a list including the job description and the characteristics of the required soft and hard skills for each role of production, was created. Purpose of this preliminary activity is to provide a simple, easy and accessible way to describe the main characteristics that workers operating in Alpha have to own. Afterwards, it wasn necessary to calculate the Degree for Role (DfR) as well as to complete the Bow-Tie table (BTt). These two activities allowed the supervisors and the Human Resource management to improve their knowledge on Alpha's production roles in terms of experience, availability, physical and mental effort and responsibility, as well as to increase their awareness on how a specific hard or soft skill can impact on the role effectiveness. Then the SDoP and WDoP indexes were calculated for each role covered by each employee. Table 3 reports an example of the evaluation of performances achieved by four employees in acting the different tasks of role R1 and specifies the Standard and Weighted Degree of Polyvalence. It can be noted that the employees E2 and E4 cannot be considered polyvalent because they lack in performing tasks T1 and T2 (employee E_2) and the task T_5 (employee E_4). On the contrary, E1 and E3 are polyvalent because they reach a sufficient level of competence in all the five tasks. Nevertheless, with a SWDoP of 0.46 data show that E_1 is more polyvalent than E4 due to a higher performance achieved in tasks T₃, T₄ and T₅.

Table 3: SDoP and WDoP of employees E1-E4 (Role R1)

DfR_1	0,68	E_1	E_2	E_3	E_4
	$SDoP_1$	0.68	0.00	0.68	0.00
	$WDoP_1$	0.46	0.00	0.38	0.00
(T_1	0.08	0.00	0.12	0.12
R_{l_j}	T_2	0.12	0.00	0.16	0.16
le (T_3	0.16	0.16	0.08	0.20
Ro	T_4	0.12	0.16	0.08	0.16
	T_5	0.20	0.12	0.12	0.00

Finally, as shown in Table 4, the evaluation of total SDoP and WDoP of each employee has been calculated, summing up the SDoP_i.

Table 4: Total SDoP and WDoP of Alpha employees (E_{1-} E_{4})

	E_1	E_2	E_3	E_4
SDoP ₁	0.68	0.00	0.68	0.00
SDoP ₂	0.00	0.00	0.02	0.32
SDoP ₃	0.22	0.00	0.02	0.00
SDoP	1.04	0.00	0.74	0.54

$WDoP_1$	0.46	0.00	0.38	0.00
$WDoP_2$	0.00	0.00	0.01	0.24
WDoP ₃	0.10	0.00	0.01	0.00
WDoP	0.89	0.00	0.48	0.32

6.2 Interpretation of results

Four additional information can be extrapolated from the analysis of the application.

Best employee identification

Once a company has filled the Bow-Tie table, it can access to the list of employees who can accomplish specific roles and the evaluation of their work. This information can be used in different circumstances, such as temporary replacement, or job rotation programs.

DoP trend analysis

The trend analysis of the employees' DoP helps managers study how employees' ability to work in a specific workstation changes over time. This information can be used to support the management of rewarding systems as well as the introduction of training programs.

Department's Total Degree of Polyvalence (TDoP) analysis

Moving the focus from a micro (employees), to a macro level (department), a Total Degree of Polyvalence (TDoP) can be calculated. The trend analysis can help managers in developing rewarding production systems as well as to enhance internal benchmarking studies.

Department's Average Degree of Polyvalence (ATDoP) analysis

The Degree of Polyvalence of each employee can be also compared with the Average Degree of Polyvalence (ATDoP) of the department he / she belongs to. This information can be used for different applications, including workforce selection. Indeed, if a company has to modify its department organisation (in terms of number and types of involved employees), the information deduced from the calculation of the Average Degree of Polyvalence can help management take the right choice.

7. Conclusions, limitations and further developments

This paper proposed an unconventional method based on a new model that includes theoretical concepts of human competences in production, linking hard and soft skills. Posing its attention on the concept of polyvalence, the proposed method is adopted to support the improvement of work variety and expansion of the employees' autonomy that in turn enhance job performances, as well as employees' satisfaction.

However, possible complications and problems can occur in the application of the proposed method.

First of all, this approach requires that some documents, as the Bow-Tie table, must be filled in by people, who may incur in involuntary mistakes. In particular, two main complications may arise: (i) supervisors, during employees' evaluation, can be influenced by their antipathy rather than sympathy to someone. For this reason 'super-partes' professional supervisors are needed; (ii) different supervisors can have different perceptions on employees' skills and then provide different evaluations. Hence, the comparison between different departments requires the implementation of a standardised evaluation approach.

In addition, managers can risk to interpret the achieved numerical results as absolute evaluations. On the contrary, numbers have to be used to obtain useful information to improve performances.

Finally, there are some situations where this application cannot produce any results, becoming a waste of time. Further research is thus needed to understand where the method is applicable and to provide some guidelines describing when and where the model can be applied fruitfully.

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