

Technology and Motivation: are we able to measure its interaction? Tecnología y Motivación: ¿somos capaces de medir su interacción?

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Fecha de recepción: 28-11-2011

Fecha de aceptación: 9-5-2012

Abstract: Taking into consideration that work motivation can be enhanced not only by increasing the levels of responsibility, meaningfulness and feedback that are built into job (intrinsic motivation), but also by improving the workers relationships, the working conditions, and the incentives (extrinsic motivation), four groups of concrete motivators have been introduced in our motivational model. For these groups of concrete motivators, a number of core dimensions have been derived, measured and evaluated given us the opportunity to establish the relationship, in terms of indicators, between the installed technology and the motivation it inspires. There have been carried out two applications of the proposed model: one in the conditions of a university in Cuba and the other in several Mexican institutions. The results obtained show the validity of the model for determining the motivational quality of working environments.

Key words: intrinsic motivation, extrinsic motivation, technology, concrete motivators

Resumen: Tomando en consideración que la motivación en el trabajo puede mejorarse no solamente por el incremento de los niveles de responsabilidad, significado y retroalimentación que están incorporados en el trabajo (motivación intrínseca) sino también por el mejoramiento de las relaciones entre los trabajadores, las condiciones de trabajo y los incentivos (motivación extrínseca), se han desarrollado cuatro grupos de motivadores concretos los cuales conforman nuestro modelo motivacional. Para estos cuatro grupos de motivadores concretos se han derivado una cierta cantidad de dimensiones esenciales las cuales se han medido y evaluado, lo que nos brinda la posibilidad para el establecimiento, en términos de indicadores, de la relación entre la tecnología instalada y la motivación que inspira. Se realizaron dos aplicaciones del modelo propuesto: una primera en una universidad cubana y una segunda en varias instituciones mexicanas. Los resultados obtenidos muestran la validez del modelo para la determinación de la calidad motivadora de los ambientes de trabajo.

Palabras claves: motivación intrínseca, motivación extrínseca, tecnología, motivadores concretos, modelo motivacional.

1. Introduction

Although motivation is often treated as a singular construct, even the more superficial analysis proposes that people are boosted to act by very different types of factors, with highly varied experiences and consequences. The construct of intrinsic motivation describes this natural inclination toward assimilation, mastery, spontaneous interest, and exploration that is so essential to cognitive and social development and that represents a principal source of enjoyment and vitality throughout life (Csikszentmihalyi and Rathunde, 1993). Intrinsic motivation is thus, the inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn. This was the base of the job characteristics theory developed by Hackman and Oldham (1976, 1980).

Hackman and Oldham's job characteristics theory describes the relationship between job characteris-

tics and individual response to work. This theory is probably the most well-known and widely discussed effort to explain the relationship of job characteristics to job satisfaction. The job characteristics theory was originally tested with the intentions of diagnosing jobs to determine if and how they should be redesigned to improve employee motivation and productivity and then later to be used to evaluate the effects of job changes on employees.

A job characteristic is an attribute of a job that creates conditions for high work motivation, satisfaction, and performance (Hackman and Oldham, 1980). They proposed five core job characteristics that should be included in any job. These characteristics are: skill variety, task identity, task significance, autonomy, and feedback. A job high in motivating potential must be high on at least one of the three job characteristics that prompt experienced meaningfulness (skill variety, task identity and task significance) and high on

both autonomy and feedback, to create conditions which foster critical psychological states.

Although intrinsic motivation is an important type of motivation, it is not the only type of motivation (Deci and Ryan, 1985). Employers must take into consideration both: job dimensions (determinant of intrinsic motivation) and the dimensions of work context of the job itself (responsible for extrinsic motivation) when redesigning work for their employees. When individuals are extrinsically motivated, they do activities for instrumental or other reasons, such as receiving a reward or receiving group support. At the same time, intrinsic motivation is more likely to flourish in contexts characterized by a sense of security, relatedness and other basic human needs.

However, there is continuing debate about the pros and cons of intrinsic and extrinsic motivation, but also there is a growing consensus that these two constructs should not be treated as polar opposites. Rather, they often both operate, and may even form a continuum. Hence, social environments can facilitate or forestall intrinsic motivation by supporting versus thwarting people's innate psychological needs. Research on the conditions that foster versus undermine positive human potentials has both theoretical importance and practical significance because it can contribute not only to formal knowledge of the causes of human behaviour, but also to the design of social environments that optimize people's development, performance, and well-being (Ryan and Deci, 2000).

How satisfied individuals are with certain aspects of their work context may affect their willingness to respond positively to enrich work (Humphrey, Nahrgang, and Morgeson, 2007). Those who are relatively satisfied with job security, working conditions, pay, group and co-worker relations, tend to respond more positively to jobs, rating high on the job characteristics, thus having a higher level of context satisfaction (Houkes, Janssen, de Jonge, and Nijhuis, 2001). These aspects of work context combine to form the context satisfaction constructs (Hackman and Oldham, 1980).

Deci and colleagues go beyond the extrinsic-intrinsic motivation dichotomy in their discussion of internalization, the process of transferring the regulation of behavior from outside to inside the individual (Deci, Koestner, and Ryan, 1999; Grolnick, Gurland, Jacob, and Decourcey, 2002). They developed a taxonomy to describe different types of motivation in-

involved in the process of going from external to more internalized regulation of motivation. This taxonomy forms a continuum.

At the left extreme is amotivation, which as the name implies, means an absence of motivation to act (Figure 1). Next are several types of extrinsic motivation that range from least to most autonomous form of motivation. At the far right of the continuum is the classic state of intrinsic motivation, the doing of an activity for its inherent satisfactions. As pointed out by Gagné and Deci (2005), extrinsically motivated behaviors cover the continuum between amotivation and intrinsic motivation, varying in the extent to which their regulation is autonomous.

Hence, the world of work has seen a vast transformation in the three decades since Hackman and Oldham published their foundational research on work redesign. Recent studies have demonstrated that full internalization of extrinsic motivation (due to the contextual factors) lead to effective performance, job satisfaction, positive work attitudes, organizational commitment, and psychological well-being (Gagné and Deci, 2005; Humphrey, Nahrgang, and Morgeson, 2007).

The evaluation by the person in the labor ambient of the subjective reflection of the meaning which objects, relations and phenomena have for that person (including job characteristics and the contextual factors in which the job is carried out), depends always on how they affect his or her needs. Thus, people's inherent growth tendencies depends on the innate physiological and psychological needs that are the basis for their self-motivation and personality integration, as well as for the conditions that foster those positive processes, i.e. the contextual environment.

In the present work we have an attempt to define a set of concrete motivators and the core motivational characteristics associated to them. The intention is to create a model useful to «measure» both intrinsic and extrinsic motivation potential and motivation quality of an installed technology.

Four groups of concrete motivators have been then introduced in our model: on the one hand, the job characteristics related to *intrinsic motivation* (according to Hackman and Oldham's theory) and, on the other, the working group, the reward system and the working conditions associated to *extrinsic motivation*. Furthermore, for these last three groups of concrete group motivators, a number of core dimensions

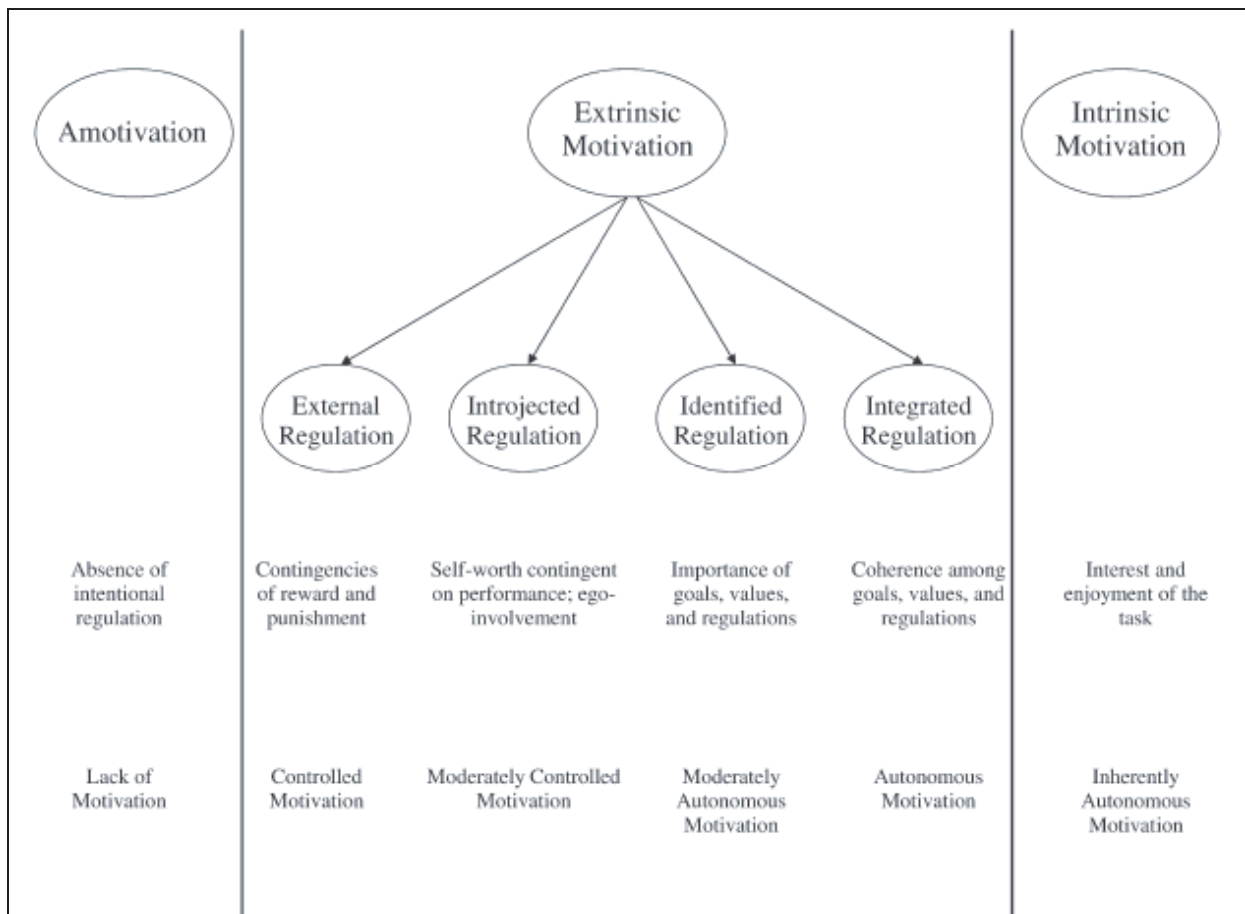
have been also derived, measured and evaluated given us the opportunity to establish the relationship, in terms of indicators, between the installed technology (we are using in this work the term technology either as the usage and knowledge of tools, techniques, and crafts or as systems or methods of organization, or as a material product of these things) and the motivation it inspires. A set of motivational indicators are developed to measure (as a kind of "motivometer") the motivational potential as well as the motivational quality of the work and the working environment.

The core dimensions are those dimensions that foster psychological states and, through them, enhance internal as well as external work motivation, associated to the possibility of needs satisfaction in that

environment. The conception of core motivational factors, firstly applied to job characteristics by Hackman and Oldham, is positively extended, in this work, to the other three groups of concrete motivators, taken into consideration the fact that "motivation is the internal state that activates, energizes, mobilizes and directs the behavior towards the attainment of the goals or motives that contain an emotional load (associated to critical psychological states) due to the satisfaction (or possible satisfaction, in the future) of a human need" (López, 2004: 22).

The relationship between core motivational dimensions for the four groups of concrete motivators and the human needs is shown in Table 1. These core dimensions will be detailed in the following sections of this work.

Figure 1
The self-determination continuum¹ (Gagné y Deci, 2005).



¹ The self-determination continuum showing amotivation, which is wholly lacking in self-determination; the types of extrinsic motivation, which vary in their degree of self-determination; and intrinsic motivation, which is invariantly self-determined. Also shown are the nature of the regulation for each and its placement along the continuum indexing the degree to which each represents autonomous motivation.

Table I
Core Motivational dimensions and their associated needs

Concrete Motivator	Core motivational dimension	Associated needs
Job characteristics	1. Skill variety	Achievement
	2. Task significance	Self-Esteem
	3. Task identity	Prestige
	4. Feedback	Power
	5. Autonomy	Acknowledgment
Group characteristics		Responsibility
		Autonomy
	6. Climate	Relatedness
	7. Cohesion	Affect
	8. Appeal	Love
	9. Variety and Distribution of Operations	Responsibility
		Achievement
Reward System characteristics		Power
		Prestige
	10. Task Identity	Autonomy
	11. Task Significance	Acknowledgment
	12. Feedback	
	13. Autonomy	
Working conditions characteristics	14. Contingency	Acknowledgment
	15. Correspondence	Power
	16. Sufficiency	Justice
	17. Righteousness	Security
	18. Perception	Physiological
	19. Coherence	
Working conditions characteristics	20. Ergonomical	Security
	21. Hygienical	Physiological
	22. Esthetical	Aesthetics
	23. Safeness	

2. The basics of the model

2.1. The Characteristics of Motivating Jobs

Technology dictates the ways that job can be carried out. Research suggests that there are a number of characteristics that could be useful in building into jobs (as a central part of the installed technology) that create conditions for high work motivation, satisfaction and performance (Hackman and Lawler, 1971; Johns, 2010; Turner and Lawrence, 1965).

Hackman and Oldham (1980) proposed that the means for increasing internal work motivation is to design jobs so they will (a) provide variety, involve completion of a whole, and have a positive impact on the lives of others; (b) afford considerable freedom and discretion to the employee; and (c) provide meaningful performance feedback.

Accordingly, they defined five dimensions associated with job content. These dimensions are:

- *Skill Variety (SV)*. The degree to which a job requires a wide range of different activities in order to

be performed, which involves the use of a certain number of different skills and talents on the employee's part.

- *Task Identity (TI)*. The degree to which a task requires the completion of a "whole" that is identifiable. In other words, doing a task from beginning to end with a visible result.
- *Task Significance (TS)*. The degree to which a task has a substantial impact on the lives or work of other people whether in the immediate organization or in the external environment.

Skill Variety, Task Identity, and Task Significance make their contributions to the experienced *meaningfulness* of the work.

- *Feedback (F)*. The degree to which performing the work activities required by the job causes the employee to receive clear and direct information on the effectiveness of his or her performance.
- *Autonomy (A)*. The degree to which a task provides great freedom, independence and discretion

to the employee in planning work and determining the procedures that will be used to carry it out.

Autonomy contributes to experienced responsibility. Autonomy refers to the degree of discretion individuals have regarding the procedures they utilize, feel they can control the sequencing of their work activities and the degree to which workers have the ability to modify or choose the criteria used for evaluating performance. Feedback from job contributes to knowledge results. Early studies showed that positive performance feedback enhanced intrinsic motivation, whereas negative performance feedback diminished it (Deci and Ryan, 1985).

According to Hackman and Oldham (1976, 1980), a given job can be very high in one or more of these five characteristics described above and, simultaneously, quite low in others. Based on that fact, it is always useful to consider the standing of a job in each of the job characteristics. Nevertheless, it also can be informative to combine the five dimensions into a single index that reflects the overall potential of a job to foster internal work motivation on the part of job incumbents.

When numerical scores are available, they are combined as follows:

$$MPC = \frac{SV + TI + TS}{3} \times A \times F$$

Where,

MPC- Motivating Potential of Work Content

SV- Skill Variety

TI- Task Identity

TS- Task Significance

A- Autonomy

F- Job Feedback

Using the diagnostic survey (see APPENDIX) that yields scores for each job characteristic ranging from a low of 1 to a high of 7 and following the above formula, this means that the lowest possible MPC for a job is 1 and the highest possible is 343 (7 cubed).

Due to the fact that the absolute values of the MPC indicator is hard to understand, we have defined the Motivating Quality of Work Content (MQC) as an

indicator of the actual job motivating potential in relation to the greatest job motivational potential.

$$MQC = \frac{MPC}{MPC_{max}} \times 100 \quad \%$$

Where,

MQC- Motivating Quality of Work Content

MPC- Motivating Potential of the Work Content

MPC_{max}- the highest value of MPC= 343

In the worst situation, the MQC value is 0,3% (when all core dimensions are rated for 1 by all the surveyed) and 100% in the best situation, when all dimensions score 7.

2.2. The Characteristics of Motivating Groups

Hackman and Oldham's theory of job characteristics focuses on facilitating high internal work motivation through intrinsic motivation, although the theory does not distinguish extrinsically forms of motivation so it does not have the means for examining negative or positive consequences that are associated with the contextual factors, responsible for extrinsic motivation or integrated motivation (the autonomous form of extrinsic motivation) (Gagné and Deci, 2005).

Pertinent to this is the finding that jobs with high motivating potential scores were associated with enhanced psychological states and better outcomes only for workers who perceived that the working group (Chen and Kanfer, 2006), pay and moral stimulus, and the working conditions were high in motivational charge (Johns, Xie, and Fang, 1992; Morgeson et al., 2010; Piccolo and Colquitt, 2006).

Technology also determinates whether the task must be performed by an individual or by a group. Starting from Hawthorne, early innovations included increased team-work, group dynamics, improving communications skills and increasing attention to improvements in the human relations climate of work organizations. The more recent approach of working teams (small group dynamics) is the aim to open up emotional as well as task related communications in order to develop mutually trusting, solid teams in which the need for relatedness could be well satisfied. Teamwork emphasizes the ability to adjusting

the equipment to the circumstances (Moreno, Ma-taix and Mahou, 2011).

This, of course, has its motivational roots, as has been proved by many researchers as Barnard, 1938; Bono and Judge, 2003; Cohen and Bailey, 1997; Cordery, Morrison, Wright, and Wall, 2010; Homans, 1950; Lewin, 1967; Likert, 1961, 1967; Mayo, 1933; Ouchi, 1980; Sosik, Avolio, and Kahai, 1997; Prado, García, Mejías and Fernández, 2010.

Baumeister and Leary (1995) put forth that the desire for interpersonal attachments is a fundamental human motivation, and found support that this is a universal need. Based on these facts, our feature is to take the group characteristics as a concrete motivational factor (Reyes and López, 2004). The fullest type of internalization, which allows extrinsic motivation to be truly autonomous, involves the integration with other interests, values and identifications. Internalization is «defined as people taking in values, attitudes, or regulatory structures, such that the external regulation of a behaviour is transformed into an internal regulation and thus no longer requires the presence of an external contingency» (Gagné and Deci, 2005, p.334).

In that order of ideas, we have developed a similar model to Hackman and Oldham's for job internal characteristics, that is, based on the fact that we can find the group characteristics that foster some psychological states in the individuals (Hackman, 1990, 2002). The dimensions that can be useful for the working group, in this regard are:

- *Cohesion (CO)*: The degree to which the group remains united with respect to the group rules by all of the members, satisfying needs of belonging.
- *Climate (CL)*: The degree to which conflicts between the group members do not exist and, if they do exist, are favourably resolved, being functional conflicts
- *Appeal (AP)*: The degree to which belonging to the group corresponds with a feeling of pride, whether due to prestige internal or external to the organization.

These three dimensions make their contributions to the «agreeability» of the group. In the other hand, following the logic developed by Hackman and Oldham, we can translate the properties of motivating individual task to attributes of motivating group tasks, that is (Brav, Andersson, and Lantz, 2009):

- *Variety and Distribution of Operations (VDO)*: The degree to which each group member is able to perform all of the tasks and operations for which the group is responsible.
- *Task Identity (TI_g)*. The degree to which the group's work can be identified in terms of one complete "piece" of work.
- *Task Significance (TS_g)*. The degree to which the group's output makes it different from the rest of the people inside or outside of the organization
- *Feedback (F_g)*: The degree to which the group, as a whole, receives reliable information on the performance of tasks.
- *Autonomy (A_g)*: The degree to which the group has freedom to decide how to perform the work, including the methods to be used, the assignment of priorities, the work pace, etc.

These eight dimensions may be combined as follows to have a single index that reflects the overall potential of the group to foster integrated extrinsically motivation:

$$MPG = \frac{VDO + TI_g + TS_g + F_g}{4} \times \frac{CO + CL + AP}{3} \times A_g$$

Where,

MPG- Motivating Potential of the Working Group

VDO- Variety and Distribution of Operations

CO- Cohesion

TI_g- Task Identity

CL- Climate

TS_g- Task Significance

AP- Appeal

F_g- Group Feedback

A_g- Group Autonomy

and, the Motivating Quality of the Group as:

$$MQG = \frac{MPG}{MPG_{max}} \times 100 \quad \%$$

Where,

MQG- Motivating Quality of the Working Group

MPG- Motivating Potential of the Working Group

MPG_{max}- the highest value of MPG = 343

Using the diagnostic instrument designed for the case (see APPENDIX), we can obtain each group characteristic ranging also from a low 1 to a high of 7. Hence, the lowest possible MPG for group is 1 and the highest possible is 343, like the model developed by Hackman and Oldham for the job characteristics. As can be seen from the equation, a very low score on autonomy will reduce the overall MGP substantially. The knowledge of results (Group Feedback) now is considered as a part of the experienced meaningfulness of the work to the group and not independently as was the case in the individual job characteristic model (Podsakoff, MacKenzie, Paine, and Bachrach, 2000).

2.3. The Characteristics of Motivating Rewards

Technology is in the same frequency of the reward system. In a technology based on the principle of division of labour, that is, in one in which the maximum work efficiency will be achieved if jobs are simplified and specialized to the greatest extent practicable, to provide motivation for employees to follow the detailed procedures, a substantial monetary bonus should be established and paid upon successful completion of each day's work. In a technology based on working groups, a reward system that recognizes and reinforces excellent group performance, when well managed, can complement and amplify the motivational incentives that are built into the group task (Cammann and Lawler, 1973; DeVaro, 2010).

The result, in many cases, will be an increase in the motivation of members to work hard and together to attempt to obtain recognition and rewards for the group as a whole (Gagné, and Forest, 2008).

Again, instead of a maintenance factor, we considered the pay and other moral rewards (such as the "pat on the back" given by the supervisor for a job well done), as many researches have demonstrated, conforming a third group of concrete motivators (López, 2004). In that order of things, we have treated this factor like those of the job characteristics theory and, thus, we have tried to find the basic essential dimensions of rewards characteristics. And they are:

- *Contingency (CY)*: as the degree to which the tangible reward is administered on a contingent basis, that is, only when the desired behaviour has actually occurred (for good performance)
- *Correspondence (CR)*: as the degree to which the tangible reward is related to the amount of knowledge and skills (competence) of the individual
- *Sufficiency (SU)*: as the degree to which tangible rewards are sufficient to cover the individual basic needs

Related to the moral rewards, we have proposed to take the following attributes:

- *Perception (P)*: as the degree to which the people understands and knows what is wanted and rewarded
- *Righteousness (R)*: as the degree to which the reward system is perceived as a right system by the individuals.
- *Coherence (CH)* or the degree to which moral and tangible rewards conform a coherent system for gratifying people for the best performance

These six reward characteristics can also be combined (after we have been scored the quantitative values for each of the dimensions) in a single motivational reward index as follows:

$$MPR = \frac{CY + CR + SU}{3} \times \frac{P + R}{2} \times CH$$

Where,

MPR- Motivating Potential of Reward System

CY- Contingency

P- Perception

CR- Correspondence

R- Righteousness

SU- Sufficiency

CH- Coherence

The first three members of the above equation are related to the material stimulus (money); the following two variables are associated to moral stimulus

and the last one has to do with the link between material and moral stimulation.

By the same way, we have developed the Motivating Quality of the Reward system (MQR) as:

$$MQR = \frac{MPR}{MPR_{max}} \times 100 \quad \%$$

Where,

MQR- Motivating Quality of the Reward System

MPR- Motivating Potential of the Reward System

MPR_{max} - the highest value of MPR = 343

Again, each reward characteristic, depending on the diagnostic instrument that is used (see APPENDIX), range from a low of 1 to a high of 7. The (MRP)_{max} is 343 and the lowest possible MRP is 1.

2.4. The Characteristics of Motivating Working Conditions

Technology is responsible for the working conditions. Another of Herzberg's (1966, 1976) hygiene factors, the working conditions, is taken in our model as a motivational one. The main reason for this is that employees look for an environment in which their security need (a basic need) could be satisfied. Work environments can range from very controlled and relatively relaxed ones to those deemed as quite hazardous and stressful (Oldham, Cummings, and Zhou, 1995). Some aspects of the safety climate as for instance, controlled risks of accidents, controlled physical environmental factors (noise, temperature, radiations, light), controlled air quality (chemical contaminants, dust), the adequate use of colors, the effective ergonomic design of tools, equipment, seats, etc., make employees feel «safety motivated» López, Pacheco, and Arce, 1995).

An old approach to improving individual-organization relationships focuses on the working conditions, that is, the conditions, determined by the installed technology, in which the work has to be done. The idea is to make the organization a personally pleasant place in which the workers could satisfy their personal psychological and security needs. And the hope is that if the work environment is sufficiently congenial, attractive and convenient, then the people will be motivated and both productive in their work and satisfied with their organizational experiences.

Achieving a safety supportive climate in working environments represents the ideal situation for the development of high levels of motivation whether in its intrinsic or extrinsic form. According to the self-determination theory, providing a healthy, safe and attractive work environment is to have paved the path to self-determination (Baard, Deci, and Ryan, 2004; Marchand, Demers, and Durand 2005).

Having this in mind, it has been developed the working conditions characteristics that foster psychological states. Those are:

- *Ergonomical, (Er)* as the degree to which the design of tools, equipment, seats and so on, are adapted, according to the workers perception, to their psychological and physiological conditions.
- *Hygienical, (H)* as the degree to which the environment is without detriments to health or well-being due to chemical (dust, gases) or physical (noise, microclimate, illumination) contaminants.
- *Esthetical, (E)* as the degree to which the environment is perceived like a clean, harmonious, pleasant place with adequate use of colors and other esthetical elements.
- *Safeness, (Sf)* as the degree to which the environment is perceived like a place with no risks (no damage possibility) for accidents, or if they do exist, they are under control.

Using the same idea, we can develop a simple index that reflects the overall potential of the four working conditions characteristics. Then:

$$MPWC = \frac{H + E}{2} \times Sf \times Er$$

Where,

MPWC- Motivating Potential of the Working Conditions

H- Hygienical

Sf- Safeness

E- Esthetical

Er- Ergonomical

$$MQWC = \frac{MPWC}{MPWC_{max}} \times 100 \quad \%$$

Where,

MQWC- Motivating Quality of the Working Conditions

MPWC- Motivating Potential of the Working Conditions

$MPWC_{max}$ - the highest value of MPR= 343

Once again, a diagnostic instrument was used which permits to have the scores for each of the four characteristics, ranging from 1 to 7. The $MPWC_{max}$ is 343 and the $MPWC_{min}$ is 1.

2.5. The Overall Concrete Motivating Potential (OCMP) and the Motivational Quality of the Working Environment (MQWE)

Finally, it is possible, using an integral indicator such as the Overall Concrete Motivating Potential of an environment to determine the motivational potential of the installed technology. Thus

$$OCMP = \frac{MPC + MPG + MPR + MPWC}{4}$$

The OCMP also range from 1 to 343.

$$MQWE = \frac{OCMP}{OCMP_{max}} \times 100 \%$$

Where,

OCMP- Overall Concrete Motivating Potential

MQWE- Motivating Quality of the Working Environment

$OCMP_{max}$ - the highest value of OCMP = 343

3. Method

Data and Sample

The empirical application of the model was carried out in two moments: firstly, 38 professors of an educational institution have been surveyed as a pilot experiment for the validity of the model using the Diagnostic Survey (see APPENDIX). The survey was carried out in the Department of Philosophy (15 professors) and in the Department of Industrial Engi-

neering (23 professors) at Holguin's High Technical Institute in Cuba. In a second moment, 546 employees of seven different Mexican institutions were also surveyed and the results were good to confirm the usefulness of the model. It was possible to determine the core critical motivational dimensions that have to be improved in each department of each institution.

Each participant completed (for his job and his context) the 23 questions related to the 23 characteristics shown in the APPENDIX. All surveyed dimensions were expressed on a 7 point scales, where 7 is high and 1 is low, and the results were averaged later to generate the profiles of each characteristic. Next, a set of equations were introduced to determine the motivational potential and the motivational quality of each group of concrete motivators. Using this model, it was possible to analyze the situation of the two departments in the Cuban institution and in the seven Mexican organizations in relation to the motivational magnitude and to highlight the critical core dimensions which have to be improved.

4. Diagnosing the installed technology for the four groups of concrete motivators at a Technological Institute

The pilot survey was carried out in the Department of Philosophy (15 professors) and in the Department of Industrial Engineering (23 professors) at Holguin's High Technical Institute in Cuba. Each participant completed the Diagnostic Survey (see APPENDIX) for his job and his context (the 23 characteristics studied above), All surveyed dimensions were expressed on a 7 point scales, where 7 is high and 1 is low, and the results were averaged later to generate the profiles shown in Table 2.

4.1. Results and discussion for the Cuban sample

Job Characteristics

In regard to job characteristics, professors of both departments viewed their jobs as high on skill variety and task significance. Considering the two groups of professors, Industrial Engineering professors rated skill variety the highest ($M = 6.46$, $SD = 0.87$), while Philosophy professors rated task significance the lowest ($M = 2.99$, $SD = 1.61$) (Table 2). Interviews with a sample of the professors of Philosophy

Table 2
Means and Standard Deviations of the core dimensions for professors of Philosophy and Industrial Engineering at Holguín's High Technical Institute

Concrete Motivator	Mean Value (Standard Deviation)	Mean Value (Standard Deviation)	Concrete Motivator	Mean Value (Standard Deviation)	Mean Value (Standard Deviation)
Job Characteristics (Core motivacional dimensions)	Department of Philosophy (n = 15)	Department of Industrial Engineering (n= 23)	Group Characteristics (Core motivacional dimensions)	Department of Philosophy	Department of Industrial Engineering
Skill	6,33	6,46	Cohesion	5,12	5,12
Variety	(0,76)	(0,87)		(0,93)	(1,04)
Task	2,99	5,37	Climate	6,19	6,4
Identity	(1,61)	(1,14)		(0,87)	(0,58)
Task	5,98	6,05	Appeal	4,98	6,33
Significance	(0,88)	(0,75)		(1,12)	(0,88)
Autonomy	4,67	5,74	Variety and Distribution of Operations	4,73	5,15
	(1,47)	(1,19)		(1,21)	(0,96)
Feedback	4,86	6,06	Task Identity	3,49	6,11
	(1,41)	(0,89)		(1,33)	(0,76)
MPC	115,75	207,32	Task Significance	5,66	6,6
				(0,94)	(0,56)
MQC	34%	60%	Feedback	5,19	6,48
				(1,10)	(0,78)
			Autonomy	5,36	6,04
				(0,97)	(0,67)
			MPG	139	234
			MQG	40%	68%
Concrete Motivator	Mean Value (Standard Deviation)	Mean Value (Standard Deviation)	Concrete Motivator	Mean Value (Standard Deviation)	Mean Value (Standard Deviation)
Reward Characteristics	Department of Philosophy	Department of Industrial Engineering	Working Conditions Characteristics	Department of Philosophy	Department of Industrial Engineering
Sufficiency	3,77	4,15	Safeness	5,11	6
	(1,31)	(1,11)		(0,96)	(1,01)
Correspondence	4,84	5,4	Esthetical	3,42	4,3
	(1,51)	(1,14)		(1,54)	(1,15)
Contingency	3,62	3,9	Ergonomical	3,85	4,87
	(1,23)	(1,05)		(1,54)	(1,23)
Perception	4,68	5,35	Hygienical	4,3	5,13
	(1,23)	(1,17)		(1,09)	(0,98)
Righteousness	4,92	5,4	MPWC	76	136
	(1,54)	(0,98)			
Coherence	3,64	4,13	MQWC	22%	39%
	(0,67)	(1,52)			
MPR	69,8	20%			
MQR	99	28%			

Department of Philosophy	Department of Industrial Engineering
OCMP = 100	OCMP = 169
MQWE = 29%	MQWE = 49%

confirmed that they felt their jobs were, on the whole, challenging and motivating, but the problem had to do with the infrequent opportunities to complete a whole “piece” (the student!) of work with a clear and visible beginning and end (task identity, 2,99). It has to be noted that they are professors of Philosophy working in a Technological Institute, where students take those subjects as a necessary evil!

The Motivating Potential of Work Content (MPC) provided by the Diagnostic Survey for job dimensions was 115 and 207 for both departments, respectively (Table 2). It leads us to calculate the Motivating Quality of Work Content (MQC) as an indicator of the part of the motivational potential that is perceived by the incumbents with values of 34% for philosophy professors and 60% for industrial engineers professors. The critical core dimensions dealing with this difference are: autonomy, feedback, and, specially, task identity.

Group Characteristics

Concerning the dimensions related to group characteristics both groups of professors rated very high in Climate and the same in Cohesion; although they differ in the rest of the dimensions. However, the “agreeability” dimensions (cohesion, appeal and climate) are higher for the engineering professors when compared to those characteristics in the Department of Philosophy.

Industrial Engineering professors rated task significance the highest ($M = 6,6$, $SD = 0,56$) and Variety and Distribution of Operations the lowest ($M = 5,15$, $SD = 0,96$), while Philosophy professors, again, rated task significance the lowest ($M = 3,49$, $SD = 1,33$), whilst Climate was rated the highest ($M = 6,19$, $SD = 0,87$) (Fig. 2). The Motivating Potential of the Working Group (MPG) was 234 (MQG = 68%) for the IE Department and 139 (MQG = 40%) for the philosophers (see Table 2).

Reward Characteristics

Concerning reward characteristics for the professors of both departments, the problems related to motivating rewards dimensions are Contingency and Sufficiency, specially the first one. In general, the three reward dimensions which deal with problems of pay seem to be psychologically unable to motivate the incumbents because of their low values. Slightly higher values for Perception and Righteousness as compared to the rest of components of the reward system in-

dicating that the moral reward system is perceived as a little more motivating as the material reward system. Problems arise with Coherence between these two reward systems as can be seen in the values obtained for this dimension in both cases.

The Motivating Potential of Reward system (MPR) has the lowest values for all groups of concrete motivators and was 69 and 99 for philosophers and industrial engineers professors, respectively. The Motivating Quality of the Reward system (MQR) was, of course, also the lowest ($MQR_{ph} = 20\%$; $MQR_{ie} = 28\%$) for all groups of motivators (Table 2).

Working Conditions Characteristics

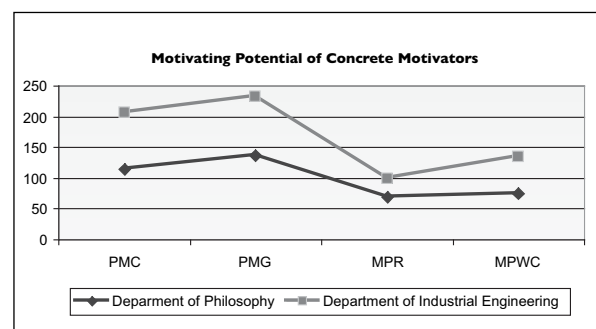
Almost all working conditions dimensions, as perceived by the professors (perhaps with the exception of the safeness conditions) have a low motivating potential, specifically the one concerned with the esthetical conditions. Low values of the Motivating Working Conditions Potential (MWCP = 76,7 and 136) for both departments was obtained by the Diagnostic Survey which can be expressed also by the low values of the Motivating Quality of the Working Environment indicator: $MQWC_{ph} = 22\%$ and $MQWC_{ie} = 39\%$ (Table 2).

Motivating Potential of each group of concrete motivators

As can be seen from Figure 2, both departments show the same shape related to the motivating potentials of the four groups of concrete motivators, although, as it has been analyzed before, professors of the Industrial Engineering Department present a more motivational situation than their peers of the philosophy department.

Fig. 2

Values of the Motivating Potential of each group of concrete motivators for the studied departments

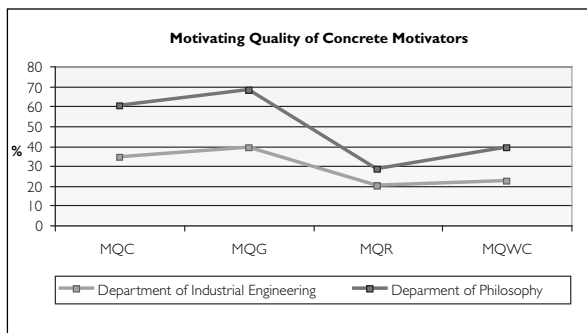


Motivating Quality of each group of concrete motivators

Not surprisingly, the shape of the Motivating Quality of Concrete Motivators is almost the same for both departments and also very similar to the shape of the motivating potential of the concrete motivators (Fig. 3)

Fig. 3.

Values of the Motivating Quality of each group of concrete motivators for the studied departments overall Concrete Motivating Potential

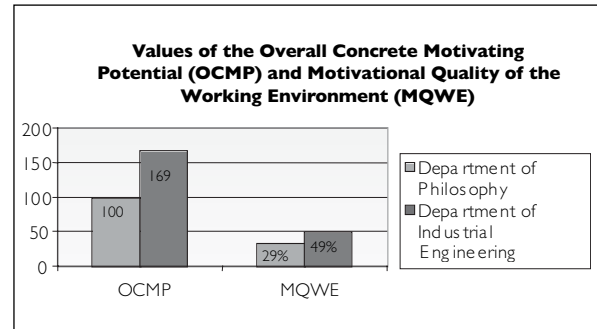


As we can see from the data (Fig. 4), the Overall Concrete Motivating Potential (OCMP) for the professors of philosophy is 100, with a Motivational Quality of the Working Environment (MQWE) equal to 29%, substantially below the Industrial Engineering Department average of 169 for the OCMP and 49% for the MQWC. The reasons for this difference have to be found in the differences in some critical core dimensions, specially the ones related to task identi-

ty (job characteristics) and in the working conditions characteristics.

Fig. 4

Values of the OCMP and MQWE for the departments under study



4.2. Results and discussion for the Mexican institutions⁷

Seven Mexican organizations (546 employees) were surveyed using - the Diagnostic Survey (see APPENDIX) which results are shown in (Table 3).

Where:

- MPC – Motivational Potential of work Content
- MQC – Motivational Quality of work Content
- MPG – Motivational Potential of the Group
- MQG – Motivational Quality of the Group

Table 3

Results for 7 Mexican organizations

ORGANIZATION	MPC	MQC %	MPG	MQG %	MPR	MQR %	MPWC	MQWC %	OCMP	MQWE %
UNIVERSITY (345)	195	57	234	68	99	28	136	39	166	48
HOTEL (69)	150	43	147	43	123	36	142	41	140	41
E-FABRICATION PLANT (39)	100	29	115	33	66	19	76	22	89	26
CAFETERIA (12)	108	31	60	17	48	14	106	31	79	23
WORKSHOP (28)	78	23	35	10	72	21	45	13	57	16
RESTAURANT (15)	61	18	75	22	41	12	24	7	5	15
BRICK FACTORY (38)	28	8	39	11	6	2	10	3	21	6

Note: Numbers in parenthesis refer to the number of surveyed employees in each organization

MPR – Motivational Potential of the Reward System

MQR – Motivational Quality of the Reward System

MPWC – Motivational Potential of the Working Conditions

MQWC – Motivational Quality of the Working Conditions

OCMP – Overall Concrete Motivators Potential

MQWE – Motivational Quality of the Working Environment

The organizations are placed in descendent order; that is, from the most motivated (the University, *MQWE* = 48%) to the less motivated workers of the Brick Factory (*MQWE* = 6%). Workers in this last organization present a very low value in practically all motivators groups, some of them with motivational quality as low as the 2% or 3% for the reward system and the working conditions, respectively. The low value for the Motivational Quality of the work Content (*MQC* = 8%) presented by the workers of the Brick Factory are the result of the mean value obtained by the survey in the five dimensions associated with job content (Table 4). It results quite clear that here all motivational core dimensions are critical.

In the other hand, the University workers present the better motivational results (*MQWE* = 48%), the

most remarkable of which is the indicator related to the working group (*MQG* = 68%) with the lowest result corresponding to the reward system indicator (*MQR* = 28%) (see Table 3). The hotel workers reach values somewhat lower (from those of the University) in three of the groups of concrete motivators. However, they feel more motivated with the reward system as the University's workers do (*MQR* = 36%).

Table 4

Work content core dimensions for the Brick Factory workers

<i>WORK CONTENT CORE DIMENSIONS</i>	<i>Mean</i>
SKILL VARIETY	2,9
TASK IDENTIFICATION	3,1
TASK SIGNIFICATION	2,5
AUTONOMY	3,3
FEEDBACK	3,0

Taking a more detailed look to the Hotel results (Table 5), it can be seen that the workers of the Stores are the most motivated in that organization (*MQWE* = 56%) followed by the reception personnel (*MQWE* = 50%); the less motivated are the workers of the Kitchen (*MQWE* = 31%).

Table 5

Results for the Mexican Hotel

<i>ORGANIZATIONAL UNITS</i>	<i>MPC</i>	<i>MQC</i>	<i>MPG</i>	<i>MQG</i>	<i>MPR</i>	<i>MQR</i>	<i>MPWC</i>	<i>MQWC</i>	<i>OCMP</i>	<i>MQWE</i>
TORES (4)	98	28	255	75	178	52	235	68	192	56
RECEPTION (6)	215	63	205	60	109	31	152	44	170	50
RESTAURANT (10)	164	47	190	55	131	38	126	37	153	45
MAINTENANCE (8)	165	47	90	26	155	45	139	40	138	40
BARS (7)	177	51	103	30	124	36	124	36	132	38
ECONOMIC DEPARTMENT (7)	119	34	178	52	52	15	170	50	129	37
ANIMATION (9)	124	36	119	34	150	44	124	36	129	37
HOUSEKEEPING (6)	131	38	134	39	79	23	114	33	115	33
KITCHEN (12)	160	46	45	13	134	39	97	28	109	31
TOTAL (69)	150	43	147	43	123	36	142	41	140	41

Note: Numbers in parenthesis refer to the number of surveyed employees in each unit

Although the workers of the Stores are the most motivated in the Hotel, they have some difficulties with the motivation derived from work content (MQC = 28%). Analyzing the core motivational dimensions of work content for those workers, it can be noted the origin of that low value (Table 6).

Table 6
Core dimensions of work content for store employees (Hotel)

CORE DIMENSIONS	Mean Values
SKILL VARIETY	5.83
TASK IDENTIFICATION	4.58
TASK SIGNIFICATION	6.50
AUTONOMY	3.00
FEEDBACK	5.83

The main trouble that could be found here arises from the low value of the perceived Autonomy (A = 3,00). Thus, what has to be done in order to enhance the motivational potential of the stores' employees? It has to be analyzed the way decisions are taken in those units are look, with employees cooperation for the ways to foster the employee's participation in decisions making.

5. Conclusions

Our approach to determine and measure the technological dimensions that are relevant in fostering work motivation, is somewhat of an extension of Hackman and Oldham's model for diagnosing job characteristics; but, in our case, following the most recent self-determination and other theories findings, which upgraded the role of the contextual factors, we have considered those contextual factors as having a similar integrated motivating potential as the enriched work can provide. Thus, work motivation can be enhanced not only by increasing the levels of responsibility, meaningfulness and feedback that are built into job, but also by improving the workers relationships, the working conditions, the incentives and so on.

Our work tries to highlight the links between basic theory about human behavior and technology, but

we agree with Hackman and Oldham's analysis that in using a diagnostic instrument we don't have a complete and exact version of the situation because it is impossible to generate a perfect diagnostic assessment of a technological system. Nevertheless, a diagnostic model such as here presented (for example, for the most critical motivating dimensions of the technology) should enter significantly into managerial choices about whether and how to proceed with technological changes.

If there is a good fit between people and their jobs (including the context), such that work is a personally rewarding experience, then there may be little for management to do to foster high motivation and satisfaction. Before organizational changes take place, the anticipated sensitive factors for employees need to be identified and analyzed. A successful manager is one who, when managing human resources, achieves the creation of a working environment that is motivating to all groups of specific motivators. To do so, he or she takes note of the essential, critical core dimensions that are provided by the diagnostics and attempts, through every channel, to increase their motivating value.

The basic notion is that if technological changes are introduced based on an evaluation of the critical dimensions of that technology, the people would be internally motivated to perform well and gains will be realized both in the productive effectiveness of organizations and in the personal well-being of the workers. The hope is also that technological changes may be a point of departure for introducing broad scale organizational changes.

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APPENDIX: DIAGNOSTIC QUESTIONNAIRE ON MOTIVATION

QUESTIONS	1 NEVER	2 ALMOST NEVER	3 FROM TIME TO TIME	4 SOMETIMES	5 FREQUENTLY	6 ALMOST ALWAYS	7 ALWAYS
1. Are you free to decide how and when you do your work?							
2. Can it be easily appreciate in the final product the result of your work?							
3. In your work, do you have to realize different operations and do you have to use a big number of skills and knowledge?							
4. Do the results of your work affect in a significant way the life or well-being of other persons?							
5. Your own work, the supervisors or other persons tell you about how well you are developing it?							
6. Can each member of your work group skillfully perform all or most of the activities which you have been assigned as a group?							
7. Can the group see the results of its work in the end product?							
8. Do the results of the group's work have an effect on the lives or well-being of other people?							
9. In your own job, do the supervisors or other people inform the group as a whole of the quality with which they are doing their work?							
10. Do the group members take part in determining the work goals and objectives?							
11. Does the group stay together to reach a shared goal after it is agreed upon?							
12. Do you feel proud of belonging to the group?							
13. Are you satisfied with the human relationships that exist among the group members and its leaders?							
14. Does the salary you receive for your work allow you to satisfy your personal needs?							
15. Is the amount of the salary you receive in line with the quality of the work you perform?							
16. Does the salary you receive match your level of preparation?							
17. Are the factors which are evaluated in order to grant rewards and select the most notable personnel known?							
18. Does the established moral stimulation system offer the greatest amount of rewards to those who really stand out the most?							
19. Are the most notable workers the ones who receive the greatest amount of material stimuli?							
20. Does the working environment offer you security?							
21. Are the hygiene conditions in your workplace favorable?							
22. Is there order and care, and is the ambience aesthetically pleasing?							
23. Do the equipment, the furniture and the space allow you to do your work comfortably?							