

EMOTIONAL INTELLIGENCE MODEL FOR DIRECTORS OF RESEARCH CENTERS IN MEXICO

MARA MARICELA TRUJILLO FLORES

Doctor in Administrative Science at ESCA-IPN (Superior School of Commerce and Administration National Polytechnic Institute) and Professor and researcher at ESIQIE-IPN (Superior School of Chemical Engineering, National Polytechnic Institute). Professor of Physics, Department of Basic Science at ESIQIE. Fellow of the Exclusive Scholarship System of COFAA-IPN (Commission for Operation and Furtherance of Academic Activities). Fellow of the IPN Academic Performance Stimulus Program.
Calle 16 A No. 11. Col. Santa Rosa. CP 07620 México DF - Tel: (5255) 5392 1203
martruj@aol.com

LUIS ARTURO RIVAS TOVAR

Doctor in Administrative Science at IPN in Mexico and Dr © in European Studies at the Institute of European Studies, Ortega y Gasset University Institute, Spain. Visiting professor at Madrid Polytechnic University, Grade 1 National Researcher. Principal of European Management Institute Plaza Río de Janeiro No. 60 (Apt.S). Col. Roma. CP 06700 México, DF
Tels: (5255) 5729 6300, Ext.61642 – (5255) 5511 8549
larivas33@hotmail.com, larivast@ipn.mx –lrivas@centromariomolina.org

Fecha de recepción: 27-02-2007

Fecha de corrección: 30-08-2007

Fecha de aceptación: 15-01-2008

ABSTRACT

The objective of this article is to show the results of IE-Martruj, a model designed for measuring emotional intelligence in directors of research centers (RCs), which was applied to forty-three directors of research centers in Mexico.

The validation model and reliability tests are described in detail, as well as the mathematical formulae used. As a general conclusion of this research, we show that: The model studied is an adequate instrument for the task proposed, and that the Emotional intelligence (EI) of directors of RCs is positively associated with: motiva-

tion, self-assessment, self-regulation, empathy and social skills.

Also, the following hypotheses were tested with positive results:

H1 - Motivation, initiative, optimism and involvement are conditions positively correlated with the effectiveness of directors of RCs.

H2 - Self knowledge, emotional awareness, precise self evaluation and self awareness are positively correlated with each other, and are essential parts of intrapersonal intelligence.

H3 - Self-regulation, self control, adaptability and self awareness are

positively correlated with each other, and are also part of intrapersonal intelligence.

H4 - Empathy, comprehension of others, development of subordinates' skills, readiness to serve, capacity to manage diversity, and political coherence exhibited by an RC director are positively correlated with each other, and are part of interpersonal intelligence.

H5 - Social skills exhibited by directors, that are also part of interpersonal intelligence, allow a director to exert a greater influence on the working group, facilitating communication, conflict management, leadership, collaboration, cooperation and development of team skills.

KEY WORDS

Emotional intelligence, Interpersonal intelligence, Intrapersonal intelligence, Models of intelligence, Assessment of intelligence, Research centers

Clasificación JEL: M12

RESUMEN

Modelo de inteligencia emocional para directores de Centros de Investigación en México

El objetivo de este trabajo es mostrar resultados del modelo IE-Martruj, concebido para la medición de la inteligencia emocional de directores de centros de investigación; fue aplicado a cuarenta y tres directores de centros de investigación en México.

El proceso de validación y confiabilidad del modelo es descrito en detalle, así como su formulación matemática. Como resultado de esta investigación, se muestra como

conclusión general que: El modelo estudiado es un instrumento apropiado para la tarea propuesta, y que la Inteligencia Emocional (IE) de los directores de centros de investigación en México está asociada positivamente con la motivación, la capacidad de autoevaluación, la autorregulación, la empatía y las habilidades sociales.

Así mismo, se sometieron a prueba, con resultados positivos, las siguientes hipótesis:

H1 - La motivación, iniciativa, optimismo e involucramiento son condiciones que se hallan correlacionadas positivamente con la efectividad del funcionamiento de los directores de centros de investigación.

H2 - El autoconocimiento, la conciencia emocional, la auto evaluación precisa y la autoconciencia están positivamente correlacionados entre ellas y son parte esencial de la inteligencia intrapersonal.

H3 - La autorregulación exhibida por los directores, su autocontrol, adaptabilidad y autoconciencia están positivamente correlacionados entre sí y también son parte de la inteligencia intrapersonal.

H4 - La empatía, la comprensión de los demás, el desarrollo de las competencias de los subordinados, la inclinación al servicio, el manejo de la diversidad y la congruencia política están positivamente correlacionados entre sí y son parte de la inteligencia interpersonal.

H5 - Las habilidades sociales de los directores, que también integran la inteligencia interpersonal, les permiten tener mayor influencia sobre

el equipo de trabajo, expresada en mayor comunicación, mejor manejo de situaciones conflictivas, y mayor liderazgo, suscitando mejor colaboración, cooperación y habilidades para el trabajo en equipo.

PALABRAS CLAVE

Inteligencia emocional, inteligencia intrapersonal, inteligencia interpersonal, modelos de inteligencia, medición de la inteligencia, centros de investigación.

INTRODUCTION

The concept of Emotional Intelligence (EI) was proposed by Salovey and Mayer in 1990, and has gained considerable currency. It was Goleman (1995), with his accessible style, who made the concept familiar to a significant number of readers, thus sparking considerable interest in the concept of EI.

This successful popularization was the point of departure for the publication of many books on the subject, some of them proposing instruments of uncertain validity. According to Goleman, EI is a set of learnable meta-abilities that enable an individual to achieve better adaptation in personal, social and work settings.

Interest in the study of EI favored the proliferation of models, many of which lacked scientific power and did not include a description of validation procedures.

This article describes the IE-Martruj model, resulting from a study that proposed to measure the correlation between the EI of directors or RCs and the productivity of those centers in Mexico. In the first part, we present the history of EI. Later we describe models that have assessed EI in different settings. By means of the design of a measurement instrument, we propose a model for determining the EI of academic leaders and directors of RCs in this country. We describe the statistical underpinnings of the model, and the subsequent range of stereotypes, defining the capacity and limitations of the resulting mathematical model, along with pertinent conclusions.

HISTORY OF EI

The development of the concept of EI over the years is heavily indebted to the work of three great authors: Galton, Thorndyke and Gardner.

In 1870, Galton was one of the first scientists who became interested in the systematic study of the “individual differences” between the mental capacities of people. To achieve this, he proposed a statistical analysis applicable to mental phenomena. One of his first attempts used questionnaires and nontraditional methods. (Roback and Kierman, 1990)

Cattell (1903) was the first American psychoanalyst to quantify stress by means of his experimental work. In 1905, Binet was commissioned by the French government to develop an instrument to assess intelligence in children. In 1916, the instrument developed by Binet-Simon was modified by Terman Lewis, and the new instrument became known as Stanford-Binet. Here, the concept of intelligence quotient appears for the first time. (Feldman, 1980)

In 1888, Thorndyke proposed the law of effect, suggesting for the first time the existence of *social intelligence*, a precursor concept of emotional intelligence. Apart from social intelligence, the same author described abstract intelligence and mechanical intelligence. (Thorndyke, 1920) In 1930, Wechsler presented the *Wechsler Adult Intelligence Scale (WAIS)*, and in 1949 the *Wechsler Intelligence Scale for Children (WISC)*. Both scales are still in use. (Evoys and Wechsler, 1981)

As from 1960, a weakening of behaviorist positions in Psychology is

observed, along with the emergence of cognitive procedures within the framework of structuralism. Piaget developed a point of view that differed from the then current ideas on human cognition; according to Piaget, study of human thought should be approached from the viewpoint of an individual that is trying to grasp the sense of the world. (Gardner, 1993) In 1978, Vygotsky found that intelligence tests provide an indication of potential development.

As from then, there have been a number of reformulations introducing the concept of rationality as a complement of the satisfaction principle, establishing the “reality principle” and the “logic of feelings”. (Ribot, 1925; Freud, 1971)

Hull proposed a physiologicistic approach and Skinner developed it on an operationalist basis. (Hall, 1951; Skinner, 1974) Another approach to the law of effect from the cognitive viewpoint was proposed by Dollar, Millar and Galperin. (Dollar and Millar, 1977; Galperin, 1979) Later, Piaget and Maslow formulated a dynamic development approach to the principle. (Piaget, 1972; Maslow, 1973)

In 1997, Sternberg proposed a conception that is associated to the “adaptation capacity” linked to emotion, memory, creativity, optimism and, to a certain extent, to mental health.

In 1983, Gardner reformulated the whole concept of intelligence through the *theory of multiple intelligences*, in which he identifies seven types of intelligence, not necessarily inter-

dependent: musical-auditory intelligence, kinesthetic-corporal intelligence, visual-spatial intelligence, verbal-linguistic intelligence, logical-mathematical intelligence, interpersonal intelligence and intrapersonal intelligence.

If we examine Gardner’s 1995 propositions, we find that two of his types of intelligence correlate closely with Thorndyke’s social intelligence: interpersonal and intrapersonal intelligence. Later, in 1997, Gardner includes *naturalist intelligence*, and in 1998 he modified his theory yet again, adding a new type: *existential intelligence*.

In 1990, P. Salovey and J. Mayer structured their conception of EI building on Gardner’s interpersonal and intrapersonal types of intelligence; however, it was Goleman’s merit to have extended the concept in 1995 with his book directed at the executive world that introduced the benefits and achievements of the study of EI to the field of administration. (Goleman, 2000)

The concept of EI proposes to answer the issue: *why are there people who adapt better than others to different situations in everyday life?* EI is made up of various meta-abilities: awareness of one’s own emotions, capacity for controlling emotions, capacity for self-motivation, recognition of the emotions of others, and control of relationships.

EI as a study field was developed by psychologists; however, there has been much important work carried out on a biological basis, such as that of LeDoux. (1987, 2002)

**EMOTIONAL INTELLIGENCE
MODELS ASSESSMENT**

As we already stated, the popularization of EI led to the creation of many models, of which even the most carefully structured suffered from limitations.

We therefore set out to analyze these models.

Both in the literature and on the consultant market there are a variety of tests that assess individual differences in the various components of EI. Our documentary search yielded

two hundred and forty models that can be divided into two basic types: ability models and mixed models.

If we select only those that present empirical evidence obtained by formal methods and validated models, there are still fifty-three. The application of an inclusion criterion that the model should be listed in *Art and Humanities Citation Index* left us with fourteen. Once all models had been limited to the administration field, there were five left, that we proceeded to examine in detail. This selection procedure is shown in Table 1.

Table 1. Results of documentary search

1st search	Classification of models	2nd search	3rd search	4th search
Models found 240	110 abilities 130 mixed	35 abilities 18 mixed	8 abilities 6 mixed	2 abilities 3 mixed

**EMOTIONAL INTELLIGENCE
MODELS IN THE
ADMINISTRATION AREA**

As mentioned above, the concept of EI has acquired many adepts in the field of administration, and is usually interpreted as the association of behaviors and emotions that are exhibited in the performance of an executive. The concept has been appropriated with enthusiasm, as it is considered vital in the business milieu to establish when an “academically intelligent” university graduate may not possess emotional intelligence or vice versa. Likewise—and notwithstanding what the compensation theory says—some individuals blend in themselves both types of intelligence (logical-mathematical and emotional).

Recent studies in the entrepreneurial field have made clear that the professionals who require a greater degree of EI are top managers, (Enebral, 2003) but it is also necessary for psychiatrists, engineers, teachers and social workers. On the other hand, programmers, lab technicians or accountants are less dependent on EI, although it is always useful.

EI models have been highly varied, including very different conceptions and abilities. (Bar-On, 1997; Cooper and Sawaf, 1997; Elias *et al*, 1999; Goleman, 1995, 1998; Guttman, 1997; Martin and Boeck, 1997; Shapiro, 1997) Of course, all the self-help books, the media, and the huge number of websites on EI that appeared at the high point of the emotional fashion, have hardly con-

tributed to give the term a scientific image. EI must establish clearer objective measures, like the perception of emotions (analogous to identification of colours, sounds and faces). So far, however, the empirical evidence is weak, as most of it was obtained using consensus methods.

We found five EI models applicable to management, with two basic types: mixed and based on abilities. Among the mixed models, those of Cooper and Sawaf, and Goleman's are especially noteworthy. Among models based on abilities, that of Salovey and Mayer is particularly worth mentioning.

Models based on abilities

Models based on abilities, as a rule, are centred on the emotional context of information and the study of abilities involved in processing it.

The first model evolved by Salovey *et al*, known as the *Trait Meta-Mood Scale* (TMMS) permits an assessment of EI, analyzing the more stable characteristics of an individual's awareness of his/her emotions and his/her capacity to control them. TMMS takes stock of the beliefs individuals entertain concerning their own emotions and their capacity to control them. Similarly, the scale evaluates an individual's beliefs referring to his/her attention capacity, clarity and ability to repair his/her emotional states. It is made up of 48 items in its "long" version, with three subscales: awareness of emotions, 21 items; clarity regarding emotions, 15 items; and emotional regulation, 12 items. (Salovey and Mayer, 1990).

This test has indices of internal consistency and convergent validity. It

has shown predictive capacity regarding emotional adjustment, and the predisposition of individuals to adapt successfully to stressful experiences; however, it must be pointed out that this instrument was designed for the educational field, where study subjects were upper level students.

Another model created by Mayer and Salovey (1995) has many points in common with the previously described instrument. It is really a revised version of the original model. It assesses EI from the point of view of a series of emotional and adaptive abilities, related conceptually according to the following criteria: a) Evaluation and expression of emotions; b) regulation of emotions; c) utilization of emotions in an adaptive way. This version is also called *Trait Meta-Mood Scale* (abbreviated TMMS with a subindex linked to the number of items contained in it) and constitutes an instrument to measure self-information on EI, elaborated on the base of 48 items arranged in three subscales that assess three fundamental dimensions of intrapersonal intelligence: emotions, 24 items; clarity concerning emotions, 12 items; and emotional reparation, 12 items. This instrument has shown adequate indices of internal consistency and acceptable convergent validity.

The authors presented a further adaptation of their model in 1997, where they enumerate, in ascending order, the different emotional abilities that constitute the concept, from the more basic psychological processes (emotional perception) to the more complex (regulation of emotional states).

The questionnaire is organized as a trait scale that evaluates meta-awareness of emotional states by means of 48 items. In other words, it rates the abilities by which we can be aware of our own emotions, as well as our capacity to regulate them.

The model built by Extremera and Fernández-Berrocal (2001) evaluates three variables: perception, comprehension and regulation. It has been used empirically in a number of studies with upper level students. The instrument has also been validated with different populations, proving to be useful both in schools and clinical settings.

As shown in Table 1, $TMMS_{24}$ is based on the *Trait Meta-Mood Scale* (TMMS) by Salovey, Mayer and their group. This scale contains three key dimensions of EI, with eight items for each of them: emotional perception, comprehension of emotions, and emotional regulation.

Mixed models

Mixed models combine personality traits such as optimism and the capacity for self-motivation with abilities for regulating emotions. These are established according to the context under study.

The EQ-map by Cooper and Sawaf, made up of 21 scales, is considered a 360° degree instrument (also known as a “wide spectrum” instrument, covering general personality traits). Although its reliability is a matter of debate, it is frequently used in the middle level administrative milieu in the United States and Canada. The model permits the exploration of EI starting from personal aptitudes and vulnerabilities vis á vis performance,

thus identifying individual and interpersonal patterns for success. (Cooper and Sawaf, 1997)

The Goleman model presents ten situations with four alternatives. It is focused toward the areas of publicity, marketing, administrative services and corporate image service. This model offers an assessment of potentials or strengths and their corresponding limits, from the point of view of information on performance. This tool covers the whole range of emotional capacities that are generally present in professional development, by means of providing a general factor of EI. (Goleman, 1995)

Another model, by Bar-On (1997) defines the following traits: intrapersonal abilities, interpersonal abilities, adaptability, stress management, and general state of mind. These traits are subdivided into fifteen major components. Due to its subcomponents—such as acceptance of reality, stress management and impulse control, among others—it is classified as a mixed model. However, as its authors have stated, it is an inventory that takes into account a wide range of emotional and social abilities. This instrument contains 133 items on five scales and 15 subscales. In its validation process, this model uses four different tests that could, each one used separately, have provided adequate validation.

Table 2 shows models, authors, type of model, definition and name of model.

METHOD AND MODEL DESIGN

Analysis of existing models persuaded us that they had been designed for environments and study subjects

Table 2. Emotional intelligence models

Field of analysis	Authors	Definition	Abilities	TYType of model	Name of model
Education area	Mayer and Salovey (1997).	<p>El is a combination of abilities that accounts for individual differences in the way people perceive and understand their emotions.</p> <p>More formally, EI is the ability to perceive, assess and express emotions precisely, the ability to obtain access to and/or generate sentiments that facilitate thought and understanding of emotions and to reason emotionally. (Mayer and Salovey, 1997; p. 10)</p>	<ul style="list-style-type: none"> • Perception, assessment and expression of emotions. • Assimilation of emotions in our thought. • Comprehension and analysis of emotions. • Reflexive regulation of emotions. 	Model based on abilities	<i>Trait Meta-Mood Scale</i> (TMMS)
Education area	Fernández-Berrocal and Extremera (2002). Adaptation of the Salovey-Mayer model.	Ability to perceive, assess and express emotions exactly, on the basis of perception, comprehension and regulation. (Fernández and Berrocal 2002)	<ul style="list-style-type: none"> • Perception • Comprehension • Regulation 	Model based on abilities	<i>Trait Meta-Mood Scale₂₄</i> (TMMS ²⁴)
Middle management area	Bar-On (1997) (Orchestrated version as a 360 degree assessment).	El is a combination of non-cognitive capacities, aptitudes and abilities that contribute to successfully cope with pressures and demands from the environment. (Bar-On, 1997; p. 14)	<ul style="list-style-type: none"> • Intrapersonal abilities • Interpersonal abilities • Adaptability • Stress management • General state of mind 	Mixed model	EQ-i
Top management area	Goleman (1995).	El includes self-control, enthusiasm, persistence and the capacity to motivate oneself. There is an outmoded word that encompasses all the range of abilities that make up EI: character. (Goleman, 1995; p. 28)	<ul style="list-style-type: none"> • Awareness of one's own emotions • Emotional management • Self-motivation • Awareness of the emotions of others • Management of interpersonal relationships 	Mixed model	EI (<i>Emotional Component Inventory</i>)

Source: Prepared by the author with material from researchers mentioned above

that did not coincide with the study subjects of our research. It must be stressed that RC directors must carry out very specific functions in their day-to-day activities. These functions can be grouped as teaching, research and service (meaning, chiefly, administration of research projects).

The study was carried out in forty-three research centers supported by CONACYT (National Council for Science and Technology) in Mexico. It involved all the centers, meaning it covered the whole Mexican Republic. Due to the small size of the sample, a census was carried out to determine its significance.

Even though we attempted to use one of the Emotional Intelligence models reported in literature, this was not possible for the following reasons: 1) The environment of the RC directors necessarily required the use of a mixed model. 2) The instrument had to meet certain specifications, according to the subjects under study. Considering this challenge, the possible instruments could only be Bar-On's EQ I, Goleman's ECI, and Oriolo and Cooper's EQ map. However, all these were rejected. 2a) Bar-On's EQ-I was discarded because it was designed for use with middle management. 2b) Oriolo and Cooper's EQ map wasn't used because it is focused on the managerial area in services and marketing. 2c) Goleman's ECI was also unsuitable because it is an instrument designed for areas such as services, marketing and publicity that have little in common with RCs.

The subject of our study was defined as a director of an RC, whose main functions are: teaching, research and service. Due to this many-faceted function, the models mentioned did not cover the multifunctional nature of the subject's work.

In Table 3, we show the characteristics of the existing models in the education and administration areas. It also shows the variables and values for validation and reliability, and subjects of study, including, as a final item, the model designed for this study (IE-Martruj).

INSTRUMENT RELIABILITY

Reliability was tested in three steps: validation of the instrument by experts; reduction of the instrument

(statistics), and validation and statistical reliability tests.

A group of national and international experts was convened, according to the following profile: psychologists (preferably social psychologists), directors of educational institutions, and methodologists, to ensure that the instrument possessed validity of content. An instrument made up of 266 items was given to this group for validation. After their comments, the instrument was reduced to 176 items.

REDUCTION CRITERIA

One of the more common problems observed in instruments that measure EI is their low discriminating capacity. To overcome this shortcoming, a reproducibility coefficient for scaleograms and the Cronbach coefficient were applied.

As a result of statistical testing, we built a new instrument that retained 48 of the original items, plus 18 new ones, making a new 66 item questionnaire. This new instrument was applied to the same pilot group after four months (experts suggest a minimum interval of three) to obtain its validation and test its reliability.

The final instrument has 52 items and 56 fields. This instrument, named IE-Martruj, was measured with:

1. Spearman-Brown (SB) techniques
2. Rulon-Guttman (RG)
3. Cronbach's alpha coefficient
4. Test-Retest method
5. McNemar's test

Tables 4 and 5 show the results.

Table 3. Characteristics of models

Authors	Model variables	Validation and reliability tests	Number of items and running time	Study subjects and areas
Mayer and Salovey (1997)	<ul style="list-style-type: none"> • Perception, evaluation and expression of emotions. • Assimilation of emotions in thought. • Understanding and analysis of emotions. • Reflective regulation of emotions. 	<ul style="list-style-type: none"> • Cronbach alpha (0.867) • Test-Retest (0.814) 	48 items 30 minutes	Students, education area
Fernández-Berrocal and Extremera (2002). (Adaptation of Salovey-Mayer Model)	<ul style="list-style-type: none"> • Perception. • Understanding. • Regulation. 	<ul style="list-style-type: none"> • Cronbach alpha (0.8859) 	24 items 20 minutes	Students, education area
Bar-On (1997)	<ul style="list-style-type: none"> • Intrapersonal abilities. • Interpersonal abilities. • Adaptability. • Management of stress. • General emotional state. 	<ul style="list-style-type: none"> • Cronbach alpha (0.7845) 	133 items 60 minutes	Personality scale, for the administrative area
Goleman (1995)	<ul style="list-style-type: none"> • Knowledge of subject's own emotions. • Emotional management. • Self-motivation. • Recognition of emotions in others. • Management of interpersonal relations. 	<ul style="list-style-type: none"> • Cronbach alpha (0.8234) • Test-Retest (0.8123) 	78 items 45 minutes	Management in marketing research, publicity and services, top management.
Oriolo and Cooper (2001)	<ul style="list-style-type: none"> • Habitual surroundings. • Emotional awareness. • Competitiveness. • Values. • Attitudes. 	<ul style="list-style-type: none"> • Cronbach alpha (0.865) 	96 items 45 minutes	Management of administrative areas.
Trujillo (2006)*	<ul style="list-style-type: none"> • Motivation • Self-knowledge • Self-regulation • Empathy • Social abilities 	<p>For reliability and validity testing, the following models was used. Halves method, in two modes:</p> <ul style="list-style-type: none"> • Spearman-Brown technique. (0.8728) • Rulon-Guttman technique (0.8544) <p>*Cronbach alpha (0.9987) Test-Retest (0.9848) McNemar test. (0.9591)</p> <p>For obtaining the mathematical model: Linear models. Multiple regression, using the correlation criterion</p>	56 items 10 minutes	<p>Directors of Research Centers whose main functions are:</p> <ul style="list-style-type: none"> • Administration • Research • Services <p>Top management area: The model was customized according to the work functions of the study subjects.</p>

- **This model obtained better factors of validation and reliability IE-MARTRUJ has its corresponding mathematical model. The model is supported by an extensive statistical base. The model has its own software that allows it to obtain results in seconds.**

Table 4. Reliability of the measurement instruments

Instrument	n	Halves method		Variance	Alpha	
		R			Correlations	
		SB ¹	RG ²	α	r	α
Pilot II 54	54	0.5468	0.5441	0.7124	0.9320	0.9987
R						
Test-Retest Method	0.9848					

¹ Spearman – Brown (SB)² Rulon – Guttman (RG)**Table 5.** Reliability of instruments according to variable (48 items)

	Test-retest	t	McNemar	Alpha					
				Correlations		Variantes		FIV ¹	
				r	p	p	I	II	I
Motivation	0.90	0.97	1.00	0.88	0.86	0.79	0.65	3.63	4.86
Self-knowledge	0.94	0.81	1.00	0.81	0.7	0.79	0.65	2.88	2.23
Self-regulation	0.94	0.72	0.29	0.67	0.72	0.67	0.81	4.79	8.84
Empathy	0.98	0.96	1.00	0.88	0.86	0.87	0.83	4.55	3.54
Social abilities	0.89	0.31	0.34	0.84	0.81	0.85	0.82	3.37	2.83
Social abilities (28)*	0.89	0.53	0.01	0.84	0.76	0.85	0.80	3.64	3.28

¹ Variance inflation factor

* Minus item 28 for reasons of balance

MATHEMATICAL MODEL (EI-MARTRUJ)

In the IE-Martruj model, intra and interpersonal EI are defined as dependent variables, while motivation, self-knowledge, self-regulation, empathy and social abilities were defined as independent variables.

The final EI mathematical model was worked out considering the ortogonality of the variables, as there was no similar instrument to follow.

Thus the model responds individually to the calculation of EI, interpersonal intelligence, intrapersonal

intelligence, and also allows the calculation of each dimension included in the model; that is, motivation, self-knowledge, self-regulation, social abilities and empathy. The respective equations follow (See equations 1, 2 and 3).

Model for EI in general:

$$IE = a_{Intra} * Intra + a_{Inter} * Inter \quad \text{Equation 1}$$

Model for intrapersonal intelligence:

$$Intra = a_{SK} * SK + a_{Mo} * Mo + a_{SR} * SR \quad \text{Equation 2}$$

Model for interpersonal intelligence:

$$Inter = a_{sa} * SA + a_{Em} * Em$$

Equation 3

In which: *Intra* = intrapersonal intelligence; *Inter* or interpersonal intelligence; *SK* = Self knowledge, *Mo* = Motivation; *SR* = Self regulation; *SA* = Social abilities; *Em* = Empathy.

Following we show the general equation for each variable (see equation 4). Mathematical model is shown in equation 5.

$$V = 6 * N_o - N_T + \sum_{i=1}^{N_T} S_i P_i$$

Equation 4

Where:

V = Value of the variable

P_i = Question number in the variable

N_T = Total number of questions in the variable

N_o = Number of negative questions in the variable

S_i = Sense of the variable (plus or minus 1)

Thus the model generates a general equation for the EI index. (See equation 5)

$$I = \sum_{j=1}^m P_j * Var_j$$

Equation 5

Where:

I = Value of the EI indicator or index
Var_j = Value of the jth variable

P_j = Weighting factor of the jth variable

Thus, the model can be used in general or for particular traits.

The proposed IE-Martruj model can be used to establish the independent value of the dimension used in the research, such as self-regulation (SR), self-knowledge (SK), motivation (Mo), social abilities (SA) and empathy (Em). To achieve this we have equation 6.

General model for dimensions

Where:

V_(IE) = Any of the dimensions: SR, SK, Mo, SA or Em (1-5)

V_i = Value of response to question

b_i = Sense of question I: 1 for posi-

$$V_{(IE)k} = \left(\sum_{i=jk}^{n_k} b_i \cdot V_i \right) + C_k$$

Equation 6

tive, -1 for negative

C_k = Scale adjustment coefficient for variable k

jk = Initial number of questions in variable k

n_k = Counter that identifies dimensions SA, Em, SR, SK, Mo (1-5)

i = Counter of sum total

k = Counter that identifies dimensions SA, Em, SR, SK, Mo (1-5)

HYPOTHESES TESTS

The general hypothesis and the working hypotheses listed in the abstract served as guidelines to carry out this study. These hypotheses were confirmed by the instrument we

designed, validated and tested for reliability, as can be observed in the following table.

High correlations were found to support formulated hypotheses.

- 1) Table 6 contains elements of proof of the working hypotheses

that, in turn, support the general hypothesis, which is:

Emotional intelligence exhibited by directors of RC's is positively associated with: motivation, self-assessment, self-regulation, empathy and social abilities.

Table 6. Response to working hypotheses

Working hypothesis	Mathematical model used	Correlation	Findings
The director of an RC presents a positive correlation between his SI and certain traits like motivation, regulation and management of his/her emotions, social abilities and empathy. The correlation obtained was 1:00 using the IE-Martruj model.	$EI = a1 * Mo + a2 * Sk + a3 * Sr + a4 * Em + a5 * Sa + b$	(1.00) High	Considering the case of the variables that make EI according to the model used, it can be observed that it is an exact linear combination of the other variables. In this case, the variance inflation factor obtained with the Anova matrix tends to infinite, as expected once the dependence of the variables had been established, as well as their correlation, that also shows their dependence. According to this, the working hypothesis is accepted.
H ₁ Motivation is highly correlated with management of emotions, optimism and affectivity. This was established by the correlation result of 0.882. It is also important to establish that this variable is part of intrapersonal intelligence.	$EI = a1 * Mo + a2 * Sk + a3 * Sr + a4 * Em + a5 * Sa + b$	(0.882) High	In the case of the motivation variable, the Anova matrix results in a correlation value of 0.882, according to which the working hypothesis is accepted. In the regression process, having proved the hypothesis, the "backwards procedure" was used.
H ₂ Awareness of his/her own emotions was highly correlated with indicators Duch as self management of emotions and precise self evaluation of emotions. This variable is also part of intrapersonal intelligence.	$EI = a1 * Mo + a2 * Sk + a3 * Sr + a4 * Em + a5 * Sa + b$	(0.823) High	In the case of the self-knowledge variable, the Anova matrix results in a correlation value of 0.823, according to which the working hypothesis is accepted. In the regression process, having proved the hypothesis, the "backwards procedure" was used.
H ₃ Regulation of emotions is highly correlated with indicators of control, adaptability and positive management of emotions, with a correlation of 0.824 according to the IE Martruj model. This variable is also part of intrapersonal intelligence.	$EI = a1 * Mo + a2 * Sk + a3 * Sr + a4 * Em + a5 * Sa + b$	(0.824) High	In the case of the self-regulation variable, the Anova matrix results in a correlation value of 0.824, according to which the working hypothesis is accepted. In the regression process, having proved the hypothesis, the "backwards procedure" was used.

Table 6. (Continuación)

Working hypothesis	Mathematical model used	Correlation	Findings
H ₄ Empathy is correlated with indicators such as comprensión of the management of other people's emotions, development of skills in personnel, readiness to serve and management of conflict. This variable is a fundamental component of interpersonal intelligence.	$IE = a1 * Mo + a2 * Sk + a3 * Sr + a4 * Em + a5 * Sa + b$	(0.839) High	In the case of the empathy variable, the Anova matrix results in a correlation value of 0.839, according to which the working hypothesis is accepted. In the regression process, having proved the hypothesis, the "backwards procedure" was used.
H ₅ Social habilidades correlated positively with indicators such as group management, ease in communication, conflict management, leadership, collaboration and cooperation. This variable is also part of interpersonal intelligence.	$IE = a1 * Mo + a2 * Ac + a3 * Ar + a4 * Em + a5 * Hs + b$	(0.880) High	In the case of the Social Ability, the Anova matrix results in a correlation value of 0.880, according, to which the working hypothesis is accepted. In the regression process, having proved the hypothesis, the "backwards procedure" was used.

- 2). It was also important to design a model to quantify EI in directors of RC's, something that hadn't been done before, either nationally or internationally.
- 3). Perhaps the most important gain derived from this work was to achieve the design of a unique model directed at determined study subjects, given that in Mexico, what little has been written on this issue is limited to analyses of developments in other countries.
- It also has the following limitations:
- The model is only applicable to directors of higher learning institutions and research centers
 - To extrapolate it is necessary to adapt the model to the study subjects and their respective environments
 - The model is valid only for the variables described

Strengths and limitations of IE-Martruj

- *It is unique in its type*
- *It has high reliability and validity*
- *It has its own operating software*
- *Its design method was tailor made for it, and recommendations from a wide range of experts were taken into account for its development.*
- *The application time is comparatively minimal (ten minutes)*
- *The instrument offers: validity of content (validated by experts); predictive validity (based on correlations); construction validity (base on Cronbach coefficient; Test-Retest, etc).*
- *The model has a rigorous statistical backing*
- *The model is an ad hoc instrument for the study subjects*
- *The model has an index for each variable*
- *The model has an index for EI*

CONCLUSIONS

The emotional intelligence between director researches centres are bad explained by traditional models of emotional intelligence for this reason has been proposed a specific model which in a contribution the field.

The motivation, self knowledge, empathy, and social abilities are the explanation variables to describe more precisely the emotional intelligence of director's research centres.

The intrapersonal intelligence is described how the capacity to manage the others emotions and the interpersonal is the capacity to manage the own emotions the emotional intelligence is consequence to sum of the inter personal and intrapersonal intelligences.

This research has been shown that the emotional intelligence for manage a research centers are different to other organizations.

This research open the possibility to analyze the emotional intelligence in another organization, is a valid speculation expected that the explanation variable for ONG, universities requires different kinds of emotional intelligence.

Is necessary continue this research in another organizations such as universities, and international agencies to prove the explanation capacity of this model.

Is valid the speculation that emotional intelligence is a contingent variable whit organizational environment

The study of emotional intelligence is complex and requires simulation

models that is not longer exist the actual models are all for diagnosis.

The universe of study is restricted to México so is necessary still going with a transnational study in order to probe if the national culture has a determinant influence in emotional intelligence.

The assumption of general intelligence is not guarantee to has emotional intelligence.

A great surprise in research directors centers is realized that not always the possession of PhD is associate with emotional intelligence.

REFERENCES

Aycagüer, Silvia (1998). *Metodología para la elaboración de instrumentos*. México: McGraw-Hill.

Bar-On, R. (1997). *The Emotional Quotient inventory (EQ-i): A test of emotional intelligence*. Toronto: Multi-Health Systems.

Cattell, J. M. (1903). Statutes of American Psychologists. *American Journal of Psychology*, 98: 134-138.

Cooper, R., Sawaf, A. (1997). *Executive EQ: Emotional intelligence in leadership and organizations*, New York: Grosset Putman.

Dollar, J. & Millar, R. E. (1977). *Personalidad y psicoterapia*. Bilbao: Deselé de Biover.

Elías, M. J.; Tobias, S. E. & Friedlander, B. (1999). *Emotional intelligence parenting: How to raise a self-disciplined, responsible, and socially skilled child*, New York: Harmony Books.

Enebral, J. (2003). *Medidas de la inteligencia emocional de las personas y*

- de las organizaciones. *Revista del conocimiento*, 12.
- Evoy, A. & Weschsler, D. (1981). *Contemporary Authors*. (Vol. 2). Detroit: Gale Research Company.
- Extremera, N & Fernández-Berrocal, P. (2001) ¿Es la inteligencia emocional un adecuado predictor del rendimiento académico en estudiantes? en *Libro de Actas de las III Jornadas de Innovación Pedagógica: La Inteligencia Emocional, una Brújula para el Siglo XXI*, Granada: 146-157.
- Feldman, D. (1980). The nature of human intelligence. In *Cognitive development*. (3a. Ed. 194-172) New Jersey: Norwood Alblex.
- Fernández- Berrocal, P., Ramos, N., (2002) *Corazones inteligentes*. (pp.35-38) Barcelona: Kairós.
- Freud, S. (1971). *Esquema del psicoanálisis*. Buenos Aires: Paidós Editores.
- Galperin, P. Y. (1979) *Introducción a la psicología. Un enfoque dialéctico*. Madrid: Pablo del Río editor.
- Gardner, H. (1993) *The Quest of Mind: Piaget, Levi-Strauss and the structuralist movement*. Chicago: University Chicago Press.
- Goleman, D. (2000) *La inteligencia emocional: ¿Por qué es más importante que el cociente intelectual?* México: Vergara Editorial.
- Goleman, D. (1995). *Emotional intelligence*, New York: Bantam Books (Traducción al castellano 1996).
- Goleman, D. (1998). *Working with emotional intelligence*, España: Vergara Editores.
- Guttman, J. (1997). *The heart of parenting: How to raise an emotional Intelligence child*. New York: Simon and Shuster.
- Hall, L. (1951) *Essentials of behavior*. New Haven: Yale University Press.
- LeDoux, J. E. (1987) Emotion. In: *Handbook of physiology. The nervous system. Journal Neuroscience Concepts*, 2, 89-99.
- LeDoux, J. E. (2002) Emotion: clues from the brain. *Annual Review of Psychology*. 46: 209-227.
- Marina, J. A. (1993) *Teoría de la inteligencia creadora*. Barcelona: Ed Anagrama.
- Martin, D., Boeck, K. (1997) *EQ, ¿Qué es inteligencia emocional?* Barcelona: Editorial EDAF.
- Maslow, A. H. (1973). *El hombre auto-realista, hacia una psicología del ser*. Barcelona: Ed. Kairós.
- Mayer, J. D. & Salovey, P. (1997) Emotional intelligence and the identification of emotional construction. *Intelligence*, 22, 89-113.
- Mayer, J. D. & Salovey, P. (1995) Emotional intelligence and the construction and regulation of feeling. *Applied and preventive Psychology*, 22, 197-208.
- Mendenhall, W. & Wackerly, D. (1994) *La estadística matemática con aplicaciones*. México: Interamericana.
- Namakforoosh, N. N. (2003) *Metodología de la investigación*. México: Limusa Noriega Editores.
- Piaget, J. (1972) *Psicología de la inteligencia*. Buenos Aires: Psique Editores.
- Ribot, T. (1925) *La lógica de los sentimientos*. Madrid: Daniel Jorro Editor.
- Roback, A. & Kierman, T. (1990) *Pictorial history of psychology and psychiatry* (3a ed.) New York: Philosophical library.

- Salovey, P. & Mayer, J. (1990) Emotional intelligence. In *Imagination, Cognition and Personality* (pp. 1985-211) New York: Basic Book.
- Shapiro, L. E. (1997) *How to raise a child with a higher EQ.*, New York: Harper Collins.
- Skinner, B. (1974). *Cuestionario de ansiedad* (4a edición), Madrid: Publicaciones de Psicología Aplicada.
- Thorndyke, E. L. (1920) Intelligence and its uses, En *Harper's Magazine*, 140, 227-285. 