Evaluating the Organizational Effectiveness with the Item Response Theory: a Case Study in Information and Communication Technology Companies

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Abstract

The aim of this paper is to measure the effectiveness of the Information and Communication Technology organizations (ICT), from the managers' point of view, using the Item Response Theory (IRT). This kind of organization is normally associated to complex, dynamic, and competitive environments, and is needed to verify its effectiveness. In academic literature, the concept of organizational effectiveness and its measurement is surrounded by disagreement. Based on the dimensions of effectiveness, a construct was elaborated: a questionnaire, which was submitted to evaluation of specialists. The results show, based on the degree of difficulty, that the manager tends to have greater agreement with concerns about innovation, items 11 (-2.653) and 14 (-3.149), respectively, than items 6 (- 1.222) and 15 (-0.324), relating to society and the environment. The construct demonstrated itself to be feasible in measuring organizational effectiveness of ICT companies, from the managers' point of view, using the Two-Parameter Logistic Model (2PLM) of the IRT. This model permits to evaluate the quality and property of each item placed within a single scale: items and respondents, which is not possible when using other similar tools.

Keywords: information and communication technology companies; two-parameter logistic model; item response theory.

1 Introduction

Organizational effectiveness is the object of many studies in the organizational field. However, according to the technical literature, several authors disagree as to its concept and measure (Sowa et al., 2004; Cameron, 1980; 1986; Forbes, 1998; Goodman, Pennings, 1977; Katz; Kahn, 1966; Rainey; Steinbauer, 1999), and others consider Organizational effectiveness evolving to a construct, containing many other concepts (Sowa et al., 2004; Goodman et al., 1983; Steers, 1977).

The emergent concerns about organizational results can be considered the basis for the effectiveness construct, are presented in the work of Adam Smith in his famous publication, "The Wealth of Nations" (1776) and in Taylor's Scientific Management (Cameron; Whetten, 1983). First, there is an interest regarding to the concept of efficiency and efficacy, to reach the concept of effectiveness. These terms may have differentiated scopes; Despite that, organizational effectiveness is still used in the field of efficiency and efficacy.

The mission of an organization is a guiding element in a company's strategic subject, which consists of a major target, and another targets derived from the external environment. "Organizational effectiveness

has always measured how successfully organizations achieve their missions through their core strategies" (Mccann, 2004, p. 43; Kushner, 2000, p. 11). In this way, organizational effectiveness, according to this article, are linked to Burke's (2009), McCann's (2004) and Kushner's (2000), and related to the "business" (with or without the purpose of profit) in their environment. Consequently, the sensibility of the organizations to their operations environment is taken into account, representing the capacity to learn, adapt and answer to the market demands. The models for the analysis of the operational environment may be an adequate reference to evaluate the organizational effectiveness. Organizations are open systems in continuous interaction with their business environment. As stated by Bertalanffy (1998), a system is an entity which has the capacity to maintain a certain level of organization in the face of internal or external changes, composed of a set of elements which interact with each other according to determined laws in order to attain a specific objective.

The actual scenario, highly competitive, forces the companies to seek alternatives to improving productivity and their survival. The internal functionality may influence effectiveness, since it is not necessarily conducive to answering market demands. In this investigation, effectiveness is emphasized to be aligned to the Geus (1998): "living company" concept, in terms for the sensibility of the organization with respect to its environmental performance, representing the company's capacity to learn and to adapt, and as such, to respond to market demands. The aim of this paper is to measure the effectiveness of the organizations Information and Communication Technology (ICT) from the point of view of the manager, using Item Response Theory (IRT). This is necessary to verify the effectiveness of the organizations, which are normally associated with complex, dynamics and competitive environments. The literature concerning ICT companies shows that the new organizational designs constitute mechanisms that are really important to economic growth, especially in developing countries where technological knowledge tends to be less fostered.

The IRT is a set of mathematical models utilized to express the association between an individual's response to an item and the underlying latent variable (many times called the "ability" or "latent trait") through a set of items. In general, IRT models measure latent traits, characteristics that cannot be directly measured, grouping a set of items and constructing a scale in which the respondents' respective latent traits can be compared with each item's difficulty (Mellenbergh, 1994, Hambleton, 2000, De Ayala, 2009).

The Item Response Theory is a tool widely used in educational and psychological field(de AYALA, 2009), and has been applied in several areas: Medicine (Roos; Meares, 1998; Vidotto et al., 2006; Das; Hammer, 2005); Marketing (Bayley, 2001; Singh, 2004); Services (Costa, 2001); Total Quality Management (Alexandre et al., 2002); Information Systems (Tezza, Bornia, Andrade, 2011); Environmental Management (Trierweiller et al., 2012); Genetics (Tavares, Andrade, Pereira, 2004). The IRT is a set of mathematical models that seeks to measure latent traits through a set of items and the construction of a scale, on the scale of the latent trait of the respondent and the difficulty of an item can be compared (Mellenbergh, 1994, Hambleton, 2000, Embretson; Reise, 2000). In this sense, the use of IRT allows: (a) to analyse items and scales, (b) to create and administer measures, and (c) to measure individuals or organizations in a construct (latent trait) of interest. The IRT is supported primarily by three reasons: (a) response function of an item, (b) information function and (c) invariance (Reise et. al., 2005).

The contribution of this study is to create of a single scale on which managers are able to interpret the scale values and, consequently, to understand the meaning of achieve a certain level of organizational effectiveness. The managers are able to visualize the principal features of the current level of organizational effectiveness, and to define the actions required to improve this current level.

This article presents the following structure: Methodological Procedures, Item Response Theory, Organizational Effectiveness, Results and Discussion, Conclusion, and References.

2 Methodological Procedures

The questionnaire was sent to all the associated companies registered in the principal entities which congregate organizations of this sector: ACATE – Santa Catarina Technology Companies Association; ASSESPRO – Association for Brazilian Information and Technology Companies and CELTA – Business Center for Elaborating Advanced Technologies. Information and Communication Technology companies, or "ICT", are originated from the computer and telecommunications industry. This industry began its initial production of microcomputers in the 1970s; continued predominant microcomputer production in the 1980s; and gained strong expansion in the 1990s in large part to the World Wide Web, which connects the current global and installed base of computers (Forumcat, 2008, Abreu et al, 2008).

Organizational effectiveness is a concept related to the General Theory of Systems according to which a system can achieve the same result as an outcome by using any one path in a range of different paths: equifinality (Von Bertalanffy, 1968). Because an organization is an open system, since it influences environment and is influenced by this same environment, it is assumed that its processes can be differentiated to achieve effectiveness.

The models to analyse organizational performance environments are innumerous. In order to perform such analysis, managers may adopt one or a mixture of these to prospect scenarios. Among them are Porter's five forces (1980), Porter's diamond (1990), Gunther's competition cycles (1995); and SWOT Analysis as conceived by Humphrey, which corresponds to Strengths, Weaknesses, Opportunities, and Threats (Kotler, Armstrong, 1998). For the purposes of this article, the Pestel model (Johnson et al., 2007) provides macro-environmental analysis in considering six factors: (1) Political, (2) Economic, (3) Social, (4) Technological, (5) Environmental, and (6) Legal. However, one must also consider the environment of the task, and to this end, was used the classification of Daft (2008): (1) Competitors, (2) Customers, (3) Suppliers, (4) Customers/Users, (5) Partners and (6) Regulators.

The methodological procedures are presented in Figure 1: (1) It was made a bibliographic survey seeking to conceptualize effectiveness and organizational structure, identifying possible constituents of these dimensions; (2) Related the effectiveness constituents in order to elaborate on an construct applicable to the scope of the study, with specialists participation; (3) Critically it was evaluated the construct, seeking to adjust it to the criteria for investigation, based on specialists; (4) Structure the evaluation questionnaire, based on relationships identified among its elements, with posterior primary evaluation, seeking to verify its applicability; and (5) Apply the questionnaire to the defined sample (Figure 1):

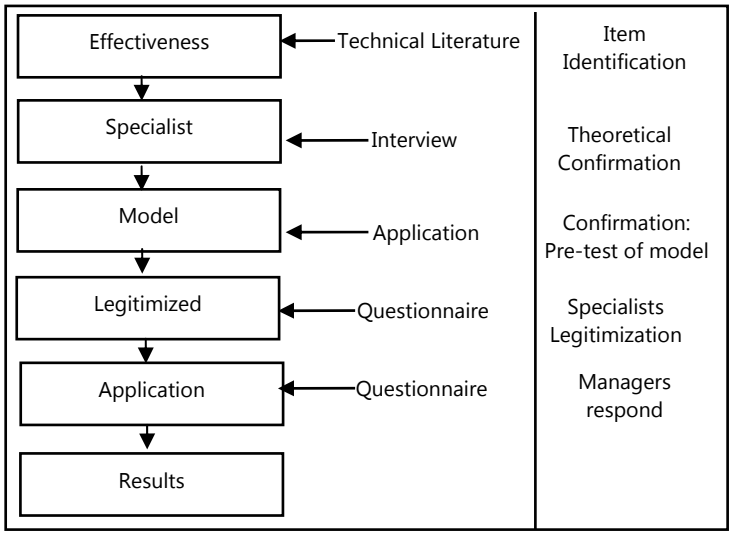

Figure 1. Methodological procedures. Source: The authors.

The questionnaire presents the items, as shown in Table 1, submitted to ICT company managers. Initially, the questionnaire presented a Likert scale and contained five response categories: SD (Strongly Disagree); D (Disagree); NA/ND (Neither Agree Nor Disagree); A (Agree); and SA (Strongly Agree). However, after

treating the data with the IRT – due to the low frequency of responses in the categories and considering the number of observations (merely 80 managers) – the responses were grouped into two categories: into category 1 called Agree (A-Agree and SA-Strongly Agree) and into category 2 Disagree (SD-Strongly Disagree; D-Disagree; NA/ND-Neither Agree Nor Disagree).

Table 1: Items of the questionnaire submitted to managers.

Numbers	Items
1	The company follows formalized Strategic Planning.
2	The company's market competition is elevated.
3	The company possesses a great variety of clients.
4	The market where the company acts is diversified.
5	The company possesses product diversification.
6	The company takes society into consideration when planning its actions.
7	The company analyses its independence with respect to suppliers.
8	The company analyses the dynamic of the economy in planning its actions.
9	The company considers the influence of regulamentory group performance on its actions.
10	Technology is a fundamental variable in company planning
11	The company evaluates its cycle of life and innovation to its products per market demands.
12	The company stimulates partnership policies with other companies in order to attain strategic collaboration.
13	The company evaluates its market image.
14	Innovation is a strategic focus for the company.
15	The company evaluates the possible environmental/ecological impact of its actions.
16	The political scenario is analysed as to its influence in company actions.

Source: The authors 2011

As to the definition of the sample, there was a certain difficulty in identifying the universe of companies in the ICT segment to be examined in this study. This same challenge was pointed out the ICT Chain Mapping Report of Santa Catarina (*Relatório do Mapeamento da Cadeia de TIC/SC*) (Abreu et al., 2008, p. 8-9), in which nearly 8000 companies of the sector were identified as the universe of this statewide industry. However, after analysis from ASSESPRO – the Association for Brazilian Information and Technology Companies (*Associação das Empresas Brasileiras de Tecnologia da Informação*) – this number was reduced to approximately 4000 companies, classified as follows: software (development and consulting), or hardware (sale of equipment /computing material and maintenance). This number was reduced at stage following the report through elimination from data inconsistencies. For example the Brazilian National Registry of Legal Entities (*Cadastro Nacional da Pessoa Jurídica* – CNPJ) showed duplicate registries involved in this study, leaving 1300 companies. However, after a simple company data confirmation via telephone, there was another reduction to 550 companies. The questionnaire was sent to these companies (managers) and only 80 responded (14.55% rate of return).

Data analysis was performed using the software R (R Development Core Team, 2008) and Bilog MG (Zimowski et al., 1996). O software R was used for the analysis of dimensionality and MG Bilog software was used to estimate the parameters of the items based on item response theory.

3 Item Response Theory

The mathematical models of the IRT estimate item and respondent parameters in order to establish a quantitative measurement scale. To estimate these parameters, one defines a set of variables which cannot be measured directly, but express a theoretical concept defined by "construct" or "latent traits", such as the "environmental management performance" to be answered for a sample of manufacturers located in Brazil. The Item Response Theory is a powerful tool that enables the construction of scales from a set of items via mathematical models (Embretson, Reise, 2000, Hambleton et al., 1991).

The IRT provides mathematical models for the latent traits, proposing forms of representing the relationship between the probability of a respondent to give a certain response to an item, and it's latent

trait and items characteristics (parameters) in the knowledge field studied. A major advantage of IRT is the principle of invariance, i.e., the item parameters do not depend on the respondent's latent traits, and the individual's parameters do not depend on the items presented. Other advantages include the possibility of comparing the latent traits of individuals of different populations when they are submitted to tests or questionnaires that have certain common items. It also allows for the comparison of individuals the same population submitted to totally different tests. Lastly, this is possible because the IRT has the items as its central elements (Bortolotti et al., 2012).

For Reckase (1997), an advantage of IRT, for other tools intended for measuring the latent trait, i.e., the Classic Test Theory (CTT) that the first seal characteristics of the item and their combinations in a test as a whole. CTT assumes that the test has already been built and be alert to the score, i.e., the individual: IRT focus item, TCT focus score. Hays et al. (2000), this advantage allows the creation of a scale in which respondents and items are allocated on the same continuum. One of the limitations of CTT is that the proficiency of the respondents and the difficulty of the items cannot be estimated separately. Furthermore, in the CTT is generated only an estimated reliability and standard error of the measurements corresponding, In IRT, each item is handled individually and has a specific error for each item.

In general, the IRT models are presented using a logistic function. The more general model for analysis of unidimensional items with dichotomous response is the 3-parameter logistic model:

$$P(U_{ij} = 1/\theta_j) = c_i + (1 - c_i)\frac{1}{1 + e^{-a_i(\theta_j - b_i)}} \quad [1]$$

Source: Author's 3-parameter logistic model (Birnbaum, 1968).

[1] Where:

- $P(U_{ij}=1/\theta_j)$ represents the probability of a positive response.
- θ_j represents the level of the latent trait. In this case, environmental management performance of industrials.
- b_i represents the difficulty of item i at a certain scale and represents the value of latent variable θ, In which there is 0.5 ou $1+c_i)/2$ probability of the individual j choosing the answer represented by $U=1$.
- The coefficient a_i is the discrimination parameter of item i, proportional to the slope of the Item Characteristic Curve – ICC at point b_i.
- The parameter c_i represents the probability of a hit casual.

During the analysis process, it created a scale related to the latent trait, with mean zero and standard deviation one, the parameters of the items are estimated (a, b, c). In the estimates are generated Characteristic Curves of the Items (CCI), in these curves we can see the probability of hitting the item depending on the skill of the respondent (θ). Figure 2 illustrates the CCI of two hypothetic items.

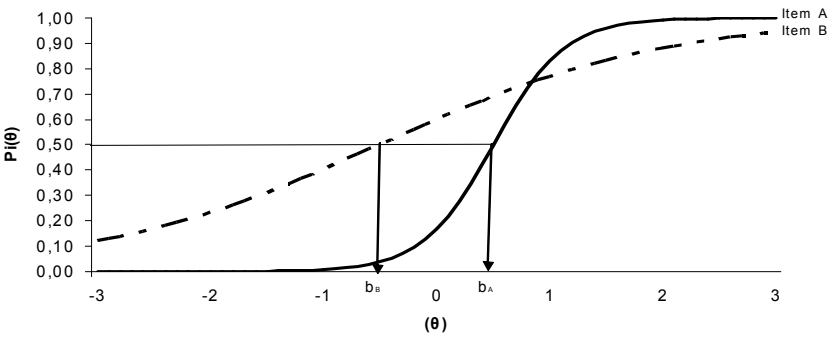

Figure 2. Characteristic Curves of the Items (CCI). Source: Tezza, Bornia, Andrade (2011)

The y-axis represents the values of the probability function Pi(θ)) ranging from zero to one. The x-axis shows the scale of ability (θ) generated by IRT. On this scale, the items and respondents are positioned.

Thus, it is possible to compare the performances of the respondents and the quality of items vertically and longitudinally. The Figure 2 shows that the item "A" requires a greater proficiency in relation to item"B". Thus, an individual with ability (θ) equal to -0.5 has a 50% probability of getting the item "B" and 4% probability of hitting the item "A".

With IRT the respondents and items are located on the same scale (metric). The responses given by a group of respondents to a measuring instrument is used for the estimation of the items and the respondents in this same scale. For an item to be useful, it must be able to differentiate between respondents located in different points along the scale. Respondents are characterized by their position on the latent variable and items are characterized according to their position and capacity to discriminate between respondents (de Ayala 2009).

According Bortolotti et al. (2012) several IRT models were developed and the main distinction between these models refers to the assumption about the relation between the answer choices of a question and the level of the latent trait. There are two types of response processes, the cumulative one and the unfolding one. Cumulative and unfolding models were developed for dichotomous or binary data and polytomous, nominal or graded, parametric and non-parametric models and unidimensional and multidimensional models. Cumulative IRT models are built on the notion in which the probability of an individual giving or choosing an affirmative answer to an item increases as his latent trait increases, i.e., higher levels of latent trait lead to a higher probability of affirmative answers, resulting in a monotonic behavior in the CCI. Among the cumulative IRT models for items with dichotomous responses: corrected as right/wrong (the case of this study). Three models are presented: the 1-parameter logistic model referred as the Rasch model (1PL), the 2-parameter logistic model (2PL) and the 3-parameter logistic model (3PL). One of the most widely used IRT models for items with dichotomous and cumulative responses is the two-parameter logistic model (2PLM) developed by Birnbaum (1968) and based on Lord (1952), which is represented by the following equation.

$$P(\theta_j, a_i, b_i) = \frac{1}{1 + e^{-a_i(\theta_j - b_i)}} \qquad \text{Equation [2]}$$

In this model, b_i is the difficulty parameter of item *i*, represented on the same scale as the latent trait θ_j, and a_i is the discrimination (or inclination) parameter of item *i*. Usually, *b* is represented on a scale with mean zero and standard deviation one. The Item Characteristic Curve (ICC) represents the $P(\theta_j, a_i, b_i)$ relationship with respect to the probability of a certain response to an item, the respondent's latent traits and the item's parameters (Santor et al., 1994).

The majority of IRT models, including the two parameter logistics model, are based on the assumption that the items measure a single latent and continuous value θ, varying from - ∞ to + ∞, or rather, that presumes uni-dimensionality of the construct.

For Reckase (2009), one advantage of the IRT in the face of other tools destined to measure latent traits such as the Classical Test Theory (CTT), is that IRT focuses of an item's characteristics and their combinations within the test as a whole. CTT assumes that the test is already constructed and focuses on the score, in other words on the individual. This leaves the IRT focusing on the items and the CTT focusing on the score. For Hays et al. (2000), this advantage permits the creation of a scale in which responding parties and items are allocated on the same continuum. One of the CTT's limitations is the proficiency of the respondents and the difficulty of the items which cannot be separately estimated. Beyond this, merely one reliability estimate is generated at a standard deviation from corresponding measurements in the CTT, while each item in the IRT is treated individually and possesses a specific error for each separately. In general, IRT models are presented by means of a logistic function.

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The uni-dimensionality of a scale may be evaluated through carrying out factorial analysis. The factorial analysis most found in literature is exploratory and confirmatory. However, in dichotomous responses, such approaches present some mathematical limitations resolved with the approach described by Bock, Aitkin (1981) and Bock, Gibbons, Muraki (1988), in which treatment of dichotomous items and estimated weights of the factors are carried out through a technique denominated full information factorial analysis, based on the item response theory. According to Reeve (2002) assuming uni-dimensionality can be examining, comparing the relationship between the first and second eigenvalue in the tetrachoric correlations matrix. This indicator demonstrates the strength of the first dimension of the data. According to Reckase (1979), if the first factor explains 20% or more of the variance of the set, one can assume uni-dimensionality. The dimensionality of a set of data may also be verified through tests such as variance analysis (Anova), Chi-squared, and the Akaide information criteria, among others (Chalmers, 2011).

Another basic assumption of the IRT is local independence, which signifies that if the level of the trait is maintained constant, there should not be any association between the responses of the items (Thissen, Steinberg, 1988). The lack of any of these two assumptions may generate unstable and inconsistent estimates.

4 Organizational Effectiveness

Organizational effectiveness has been the subject of many studies prior to this one. However, one quickly notes that innumerous authors declare disagreement surrounding the concept itself and its measurement: Sowa et al., 2004, Cameron, 1980, Banner, Gagné, 1995, Forbes, 1998, Goodman, Pennings, 1977, Katz; Kahn, 1966; Brunet et al., 1991, Rainey, Steinbauer, 1999. The examples of Sowa et al. (2004), Thibodeaux and Favilla (1996), Goodman et al. (1983) show that organizational effectiveness integrates innumerous others concepts and has evolved into a construct.

There is a proliferation of studies on ideal organizational types, but the conflict concerning such an ideal has given origin to a "contingency model." There are many authors worthy of highlight for such an approach, such as Burns and Stalker (1961), Lawrence and Lorsch (1967), Van de Ven and Ferry (1980). In their view effectiveness evaluations differ according to environmental circumstances. Under such a perspective, effectiveness depends then on correspondence among an organization's attributes and its environmental conditions, thus deserving the denomination of contingency approach. The Table 2 presents a summary of the historical considerations of the concept of organizational effectiveness.

The organizational effectiveness, in this article is aligned to (Burke, 2009, Mccann, 2004, Kushner, 2000) and it is related to the "business" and it is considered in terms of the sensitivity of the organization in relation to its business environment, representing the ability to learn, adapt and respond to market demands. The mission of an organization is an element to guide their strategic issues; it is a larger goal, from which all other goals are derived. However, in the literature there is discordance between the concept of organizational effectiveness and its measurement.

Radner (1992) affirms that being effective signifies possessing the competency to outline and implement good strategies. For Marinho and Façanha (2001, p. 6) statement: "Organizations are effective when their decisive criteria and their achievements point to permanence, structure true objectives, and construct trustworthy rules of conduct endowed with credibility towards those who make up the organization and their performance environment." McCann (2004, p. 43) says: "Organizational effectiveness has always measured how successfully organizations achieve their missions through their core strategies." Kushner (2000, p. 11) explains "We define organizational effectiveness as continued success in carrying out an organization's mission," while for Burke (2009), non-profitable organizational effectiveness is evaluated by the ability to complete one's socially defined mission. In this article, organizational effectiveness is taken to signify "doing the right thing over time," with results corresponding to guaranteeing the business, it represents the capacity to learn and adapt and respond to market demands. The mission of an organization is its guiding principle in answering strategic questions. It deals with a greater goal for the organization, to which all others are tied in their existence in the external environment, demonstrating the

strategic scope inherent to the concept of effectiveness. Organizational effectiveness depends upon how organizations orient themselves with respect to external environment forces (Kast, Rosenzweig, 1972, Katz, Kahn, 1966).

Table 2: Historic background on organizational effectiveness.

History of organizational effectiveness	
Authors and their time	*Perception of Organizational Effectiveness*
1950 decade	
Selznick (1948)	Besides the organization conceived in terms of the reach of targets, considered its internal system and its relation with the environment.
Bronowski (1959)	Personal satisfaction and effectiveness are related: to the extent where satisfaction increases, effectiveness increases as well.
1960 decade	
Burns and Stalker (1961)	The systemic thought offers the basis for several new perspectives such as the Theory of Contingency, where the importance of the adjustment between strategy and structure is highlighted as a determinant of performance.
Seashore (1962)	An effective organization is one which is concerned with the dependence on resources.
Argyris (1964)	Founded on the problem of integration between individual and organization.
Katz and Khan (1966)	Organization is an open dynamic system.
1970 decade	
Goodman and Pennings (1977)	Organization is effective if the demands composing each of its components are satisfied.
Campbell (1977)	The criteria of effectiveness are a political process.
Pfeffer and Salancick (1978)	The organizations become effective by the existence of interdependence amongst the resources and by answering to the needs of the groups that control these resources.
Reddin (1979)	The organizations have cycles of life similar to that of the human being, an effective organization is the one capable of making adaptations amidst the environment changes.
1980 decade	
Weick and Daft (1983)	It depends on the capacity of the top managers to understand and interpret the messages given by the workers and by the organizational environment where they develop their tasks, as well as the perspicacity to detect and recognise the limits of their actions in this environment.
Quinn and Rohrbaugh (1983)	The scientific studies turn to the generation of models, for example, the *Competing Value Framework*.
1990 decade	
Brunet *et al.* (1991)	Investigations have been observed with regards to the construct of organizational effectiveness Defining organizational effectiveness in a way that it can be universally accepted is a difficult task.
Banner and Gagné (1995)	The theme organizational effectiveness is surrounded by ambiguity and confusion.
Thibodeaux and Favilla (1996)	A universal theory about the subject still hasn't been developed.
First decade of 2000	
Lusthaus *et al.* (2002)	Organizational effectiveness is defined as an extension where an organization is capable of achieving their targets. Related to pioneer studies (Theory of Targets), despite being criticized for its simplicity, it is still used.
Selden and Sandfort (2004)	They study effectiveness in organizations without purposes of profit.
Moraes (2007)	The term effectiveness is not a consensus among scholars but it has suffered development.
Balduck and Buelens (2008)	They review the concept of effectiveness and investigate the distinct characteristics between effective and non-effective organizations.
Burke (2009)	Effectiveness in organizations without purposes of profit is evaluated by the capacity to accomplish their mission, socially defined.

Source: The authors 2011

For Balduck and Buelens (2008) organizational effectiveness is one of the basic constructs of organizational theory. These authors look to Goodman and Pennings (1977) to affirm that effectiveness is central to studying organizational analysis and organization theory must include the study of this construct, even with the controversy over what it constitutes and how it should be measured. Evaluating effectiveness is based observing the concepts that compose it (Matitz, 2008). Organizations possess multiple objectives to be attained, considering their limited resources and conflicts of interests among the groups that compose them, demonstrating a lack of consensus among academics both with respect to the concept of effectiveness and to criteria for its evaluation, even with incessant research towards these questions (Georgopoulos, Tannenbaum, 1957, Katz, Kahn, 1966, Cameron, 2005, Carvalho, Gomes, 2002).

One must consider the concern for stakeholders' demands and the necessary adaptation on the part of organizations in responding to such demands. The focus is on transactions beyond organizational boundaries and their interactions with multiple constituents (Goodman, Pennings, 1977, Connolly et al., 1980, Tsui, 1990). In this article a contingency focus is adopted for how environmental factors affect organizational effectiveness. The constituent under analysis is the manager and his/her perception with respect to the effectiveness of the organization of which he/she is part.

In order to do so, the Item Response Theory (IRT) is used towards the objective of measuring organizational effectiveness in Information and Communication Technology (ICT) companies from a managers' perspective.

5 Results and Discussion

Table 4 shows the parameters estimated for the 16 items based on a sample of 80 managers of ICT companies in a scale with zero mean standard deviation 1. It is observed that the ordering of items according to the degree of difficulty is represented by the parameter b.

According to Hair et al. (2009), in the factorial analysis model, each of the variables can be defined as a linear combination of the common factors which will explain the portion of the variance of each variable, but a deviation which sums up the portion of the total unexplained variance from these factors. The portion explained through common factors has been called commonality. Commonalities may vary from 0 to 1, with values close to 0 indicating that common factors do not explain the variance and values close to 1 indicate that all the variances are explained through common factors.

Full-information factor analysis (Bock et al., 1988) with the R Software (R Development Core Team, 2011) was used to verify the dimensionality of the construct. The Reckase (1979) limit of 20% of the total variance was used to assess the unidimensionality of the construct.

The results of full information factor analysis may be visualized in Table 3. This analysis showed that the first factor is responsible for 21.3% of the variance explained in the model and the correlation for the factors is 42%. One may verify that, from a statistical point of view the majority of the items are strongly characterized from Factor 1, with the exception of items 2 (The company's market competition is elevated), 3 (The company possesses a great variety of clients) and 4 (The market where the company acts is diversified). These items were initially elaborated with the objective of better understanding the profile of those who responded with respect to their market. As has been stated, given the scenario of analyzed TIC companies, this can occur through the fact of managers being geared to the local, regional, and national market and their concern has become directed to more specific economic questions referring to the internal market from a national approach.

The IRT analysis was performed with BILOG-MG® software. This software, developed by Scientific Software, Inc. (Mislevy and Bock, 1990) is one of the most popular IRT programs. The IRT model used was the two-parameter logistic model (2PLM) (Eq. (1)). The BILOG-MG® program performs the analysis in three phases distinguished by the type of tasks performed in each phase (Tezza, Bornia, Andrade, 2011).

In phase 1, some basic statistics from classical testing theory are calculated for each item. These statistics include the percentage of positive responses and the biserial correlation. This phase provides a preliminary evaluation of the items. In phase 2, the constructed items are calibrated. The calibration of the items yields statistical estimates of the item parameters. According to Embretson and Reise (2000), the results of this phase and the next phase are directly influenced by model choice and, consequently, by the number of parameters, the number of items and the sample size. Phase 3 includes the estimation of the Organizational Effectiveness Level of each company analysed, it is estimated from the results obtained in the previous phase. BILOG MG® also provides informative graphs. These graphs include characteristic curves and information curves for each item as well as the total information curve for the test. Through this analysis and according to Reckase (1979), the construct may be considered unidimensional, fulfilling one of the principle assumptions in utilizing the two parameter logistics model.

Table 3: Full information factorial analysis and 16 item promax rotation

Items	Factor 1	Factor 2	Commonality
1	0.808	-0.243	0.546
2	0.107	0.303	0.130
3	-0.070	0.749	0.522
4	-0.111	0.985	0.890
5	0.554	0.305	0.542
6	0.308	0.040	0.107
7	0.610	0.043	0.396
8	0.486	0.261	0.411
9	0.516	0.012	0.272
10	0.126	0.019	0.018
11	0.448	-0.082	0.176
12	0.253	0.285	0.206
13	0.429	-0.064	0.165
14	0.550	0.157	0.399
15	0.376	-0.192	0.118
16	0.383	-0.379	0.168

Source: The authors 2011

A more rigorous statistical analysis of dimensionality utilizing variance analysis (Anova) showed that at a 5% significance level the unidimensionality was at its limit, which reinforces the question that any statistical analysis must be supported by the theoretical construct and the view of management practices in the ITC sector, considering the characteristics (macro and micro factors) upon utilizing models to the tune of the contingency theory.

Table 4 shows the parameters estimated for the 16 items based on a sample of 80 managers of ICT companies in a scale with zero mean standard deviation 1. It is observed that the ordering of items according to the degree of difficulty is represented by the parameter b.

In practical terms, based on the parameter b, is more likely that a manager who has a perception of effectiveness of your business around -2.000, agrees with the items 10 (-4.199) 14 (-3.149) 11 (-2.653) and 08 (-2.632). It is likely that he does not agree with the other items once they are above their perceived degree of effectiveness. Item 10 has a lower degree of difficulty that the item 13 (-1.746), because the item 10 is related to technology, A subject that is inherent in ICT companies (Information and Communication Technology), while item 13 "The company evaluates its market image" seems not to be the focus of concern manager, which justifies the position of items.

Still based on the degree of difficulty, it appears that the manager tends to have greater agreement with concerns about innovation, items 11 (-2.653) and 14 (-3.149), respectively, than items 6 (- 1.222) and 15 (-0.324), relating to society and the environment.

Regarding the analysis of the latent trait (degree of effectiveness of the company based on the perception of the manager), as Table 5 show that, when selecting managers who responded to all 16 items, for example, the manager G13 and G20, observed that the degree of proficiency or effectiveness of these respondents is different, even if they agreed with 10 items, whereas the agreement took place on different items. The G20 has a higher proficiency (higher degree of effectiveness) than the G13. This feature proves an advantage of Item Response Theory (IRT) in comparison to the Classical Test Theory (CTT), because it was considered the assumptions of TCT, the conclusion is that they have the same score, because the TCT is not positioned item and respondent on the same scale.

Table 4: Parameters of the items

	a	b
Item 10	0.821	-4.199
Item 14	1.024	-3.149
Item 11	0.679	-2.653
Item 08	0.863	-2.632
Item 07	0.643	-1.899
Item 13	0.710	-1.746
Item 12	0.867	-1.736
Item 02	1.025	-1.648
Item 09	1.092	-1.255
Item 06	0.777	-1.222
Item 01	0.930	-1.101
Item 03	1.166	-1.081
Item 16	0.793	-0.596
Item 04	0.913	-0.365
Item 15	0.841	-0.324
Item 05	0.941	0.003

Source: The authors 2011

Table 5: Estimates of the degree of effectiveness for some respondents

Manager	Num. Items Responded	Items Responded Positively	% Correct	Level of Organizational Effectiveness	Standard Error	Items in Agreement
G1	16	7	43.75	-1.326	0.520	2;8;9;10;12;13;16
G2	16	8	50.00	-1.245	0.522	6;7;8;10;11;12;14;16
G3	16	15	93.75	1.064	0.676	1;2;3;4;5;6;7;8;9;10;11;12;14;15;16
G13	16	10	62.50	-0.776	0.544	1;2;6;7;8;10;11;12;13;16
G20	16	10	62.50	-0.459	0.546	1;2;3;8;9;10;11;12;13;14

Source: The authors 2011

In a practical situation, it is possible to compare companies in terms of Organizational Effectiveness to perform a type of benchmarking. Moreover, the examination of the company's position on the scale can identify groups of concepts that dominate the company's performance and concepts that need improvement.

6 Conclusion

Based on the results obtained, one can verify the viability of measuring the organizational effectiveness of ICT companies from the perspective of management using the IRT. The IRT presented several advantages

with respect to selecting items which made up the questionnaire as it permits quality and property evaluations for each individual item involved in the study and places items and responses within a single scale, going beyond the limitations of other analysis tools. The study carried out herein showed itself to be particularly useful in evaluating individual constructs that are otherwise difficult to observe and extract, such as management perceptions of organizational effectiveness. One must highlight that due to the fact of utilizing the IRT, there is also the advantage of providing internal information from the items, which permits a verification concerning the positioning of the company's degree of effectiveness. For example, the item 10 has a lower degree of difficulty that the item 13 (-1.746), because the item 10 is related to technology, an issue inherent in this sector (Information and Communication Technology companies), while item 13, referring to the image of company in the market seems not to be the focus of concern manager, which justifies the position of items.

Measuring effectiveness among Information and Communication Technology companies also proved to be viable with the utilization of the Item Response Theory and the Samejima Graded Response Model (GRM) de Samejima (1969), according to a study of Trierweiller et al. (2011).

One advantage of Item Response Theory in comparison to the classical theory of tests is that the Item Response Theory allows estimating the degree of organizational effectiveness based on a scale, Table 5 shows that, when selecting managers who responded to all 16 items, for example, the manager G13 and G20 observed that the degree of proficiency or effectiveness of these respondents is different, even if they agreed with 10 items, whereas the agreement took place on different items. The G20 has a higher proficiency (higher degree of effectiveness) than the G13. This feature proves an advantage of Item Response Theory (IRT) in comparison to the Classical Test Theory (CTT), because it was considered the assumptions of CTT, the conclusion is that they have the same score, because the CTT is not positioned item and respondent on the same scale.

As to the limitations of the organizational effectiveness questionnaire, presented in Table 1 of this article, it is suggested the construction of a greater number of items as well as submitting them to a larger sample of management respondents. After amplifying the instrument, it is suggested that it applied to other stakeholders as well as ICT companies from other regions of Brazil in order to perfect the instrument, seeking greater representation of the segment analyzed.

Finally, this article does not present a definitive tool for application, since more items are necessary to increase its survey, including the consideration of other regions in Brazil and other countries.

It would also be interesting to build a computerized adaptive test (CAT) for the respondent (manager) – the end of the questionnaire – get, immediately, the degree of effectiveness of your company. As such, a greater reach of the instrument should be considered with the objective to contribute to business management in the ICT sector through measuring the effectiveness of these organizations.

References

Abreu, A.F., Machado, C. dos R., Santos, D. da S., Trzeciak, D.S., Polacinski, E., Scotini, E., Schenatto, F.J.A., Abreu, P.F., Rother, R.G (2008). *Mapeamento da cadeia de Tecnologia da Informação e Comunicação de Santa Catarina* (Report of the chain of Information Technology and Communications of the State of Santa Catarina), Florianópolis, Brazil, IEL/SC. Federal University of Santa Catarina.

Argyris, C. (1964). *Integration the individual and the organization*. New York: Wiley.

Balduck, A.L., Buelens, M. (2008). *A two-level competing values approach to measure nonprofit organizational effectiveness,* Ghent University: Vlerick Leuven Gent Management School.

Banner, D.K.; Gagné, T.E.(1995). *Designing effective organizations*: Traditional and transformational views. Thousand Oaks: Sage.

Bayley, S. (2001). Measuring customer satisfaction. *Evaluation Journal of Australasia*, v. 1, 1.

Bertalanffy, L.V. (1968). *General system theory: foundations, development, application.* New York: George Braziller.

Birnbaum, A. (1968) Some latent trait models and their use in inferring an examinee's ability, contributed chapters. *In*: Lord, F.M., Novick, M.R. Eds. S*tatistical Theories of Mental Test Scores*. Addison Wesley: Reading, MA.

Bock, R. D., Aitkin, M. (1981). Maginal maximum likelihood estimation of item parameters: Application of an EM algorithm. Psychometrika, v.46, 443-445.

Bock, R. D., Gibbons, R., Muraki, E. (1988). Full information item factor analysis. Applied Psychological Measurement, v.12, 261–280.

Bortolotti, S.L.V.; Tezza, R.; Andrade, D.F de , Bornia, A.C.; Sousa Júnior, A.F de. (2012). Relevance and advantages of using the item response theory. *Quality and Quantity*, v. 46, 714-728.

Bronowski, J. (1959). *Science and human values*. New York: Harper & Row Publishers.

Brunet, L.; Brassard, A.; Corriveau, L.(1991). *Administration Scolaire et efficacité dans les organizations*. Montréal: Éditions Agence DÁRC.

Burke, S.P. (2009). *Capital expansion and organizational growth: a cost-effective analysis for Huntington family centers*. BA, Suny Cortland, Capstone, J. Project: Submitted in partial fulfillment of the requirements for the degree of Masters in Public Administration in the Graduate School of Binghamton University, New York.

Burns, T.; Stalker, G.M. (1961). *The management of innovation***.** London: Tavistock.

Cameron, K.S. (1980). Critical questions in assessing organizational effectiveness. *Organizational Dynamics*, autumn, 66-80.

Cameron, K.S. (1986). A study of organizational effectiveness and its predictors. *Management Science*, vol. 32, 87-112.

Cameron, K.S. (2005). Organizational effectiveness: its demise and re-emergence through positive organizational scholarship. *In* Hitt, M.A and Smith, K.G. *Handbook of management theory: the process of theory development*, Oxford University Press London.

Cameron, K.S.; Whetten. (1983). D.A. *Organizational effectiveness*: a comparison of multiple models. New York: Academic Press.

Campbell, J.P.(1977). On the nature of organizational effectiveness. *In* Goodman, P.S. & Pennings, J. M. (Eds.). *New perspectives on organizational effectiveness* (13-55). San Francisco: Jossey-Bass.

Carvalho, C., Gomes, A.D. (2002). Eficácia organizacional: construção de um instrumento de medida e questões em torno de sua avaliação. *Revista Psicologia e Educação*, 1, 15-37.

Chalmers, P. (2011). *Package 'mirt' verson 1*-16. Retrieved on Jan. 11, 2011. Acessed from: www.r-project.org.

Connolly, T., Conlon, J., Deutsch, S.J.E. (1980). Organizational effectiveness: a multiple-constituency approach, *Academy of Management Review*, 5, 211-217.

Costa, M.B.F. (2001). Técnica derivada da Teoria de Resposta ao Item (TRI) aplicada ao setor de serviços (Technique derived from Item Response Theory applied to the service sector). 2001. *Dissertação* (Dissertation Master Degree) – Programa de Pós-Graduação em Métodos Numéricos em Engenharia (Post Graduation in Numerical Methods in Engineering). Universidade Federal do Paraná (Federal University of Parana), Curitiba, Brazil.

Daft, R.L. (2008). *Organizações: teoria e projetos*. (Organizations: theory and design). São Paulo: Cengage Learning.

Das, J., Hammer, J. Which doctor? (2005). Combining vignettes and item response to measure clinical competence. *Journal of Development Economics*, 78, 348-383.

De Ayala, R. J. (2009). *The theory and practice of Item Response Theory*. New York: The Guilford Press - New York Wiley.

De Geus, A. (1998). *A empresa viva: como as organizações podem aprender a prosperar e se perpetuar*. (The living company: how organizations can learn to thrive and perpetuate). Rio de Janeiro: Campus.

Embretson, S.E., Reise, S. P. (2000). Item response theory for psychologists. New Jersey: Lawrence Erlbaum Associates.

Forbes, D.P.(1998). Measuring the unmeasurable: empirical studies of nonprofit organization effectiveness from 1977-1997. *Nonprofit and Voluntary Sector Quarterly*, 27, 183-202.

Forumcat. (2008). *Fórum Catarinense de Desenvolvimento* (Catarinense Development Forum) Retrieved on Feb. 10, 2010. Acessed from: http://www.forumcat.org.br.

Georgopoulos, B.S., Tannenbaum, A.S. (1957). A study of organizational effectiveness. *American Sociological Review*, 22, 534-540.

Goodman, P.S., Atkins, R.S., Schoorman, F.D. (1983). On the demise of organizational effectiveness studies in K. Cameron, D. Whetten, *Organizational effectiveness*: a comparison of multiple models. New York: Academic Press, 163-83.

Goodman, P.S., Pennings, J.M. (1977). Toward a workable framework. *In* Goodman, P.S. and Pennings, J. M. (Eds.). *New perspectives on organizational effectiveness.* San Francisco: Jossey-Bass, 146-84.

Goodman, P.S., Pennings, J.M.(1977). Toward a workable framework. *In* Goodman, P.S., Pennings, J.M. (Eds.), *New perspectives on organizational effectiveness* (146-84). San Francisco: Jossey-Bass.

Gunther, R. (1995). *Hyper-competitive rivalries: competing in a highly dynamic environment.* New York: Free Press.

Hair, J. F., Anderson, R.E., Tatham, R.L., Black, W.C. (2009). *Análise multivariada de dados*. 6. ed. Porto Alegre: Bookman.

Hambleton, K., Swaminathan, H., Rogers, H.J. (1991). *Fundamentals of item response theory.* Newbury Park, Sage, CA.

Hambleton, R.K. (2000). Emergence of item response modeling in instrument development and data analysis. *Medical Care.* 38 (9), 60-65.

Hays, R.D., Morales, L. S., Reise, S. P. (2000). Item Response Theory and Health Outcomes Measurement in the 21st Century. *Medical Care*, v. 38, 9, II-28–II-42.

Johnson, G., Scholes, K., Whittington, R. (2007). *Explorando a estratégia corporativa* (Exploring corporate strategy), Bookman, Porto Alegre.

Kast, F.E., Rosenzweig, J.E. (1972). General systems theory: applications for organization and management. *Academy of Management Journal*, 15, 447-465.

Katz, D., Kahn, R.L. (1966). *The social psychology of organizations.* New York: John Wiley & Sons.

Kotler, M., Armstrong, G. (1998). *Administração de marketing: análise, planejamento, implementação e controle*, 5ª. ed., São Paulo: Atlas.

Kushner, R.J. (2000). *Facilitators guide for assessing organizational effectiveness in national societies: a resource for organizational development facilitators in the international Red Cross*. Red Crescent Movement. International Services Department: Technical Assistance, Planning and Evaluation Unit. Washington, DC.

Lawrence, P.R., Lorsch, J.W. (1967). Organization and Environment, Division of Research. *Harvard Business School*, Boston, MA.

Lord, F.M. (1952). A theory of test scores. *Psychometric Monograph 7*.

Lusthaus, C., Adrien, M.H., Anderson, G., Carden, F.; Montalván, G.P. (2002). *Organizational assessment: a framework for improving performance*. IDRC/ IDB. Disponível em:< ff.idrc.ca/en/ev-23987-201-1-DO_TOPIC.html> Acesso em set. 2008.

Marinho, A., Façanha, L.O. (2001). *Programas sociais: efetividade, eficiência e eficácia como dimensões operacionais da avaliação* (Social programs: efficiency and effectiveness and operational dimensions of the evaluation), Texto para discussão (Text for discussion), n. 787, IPEA – Instituto de Pesquisa Econômica Aplicada, Rio de Janeiro.

Matitz, Q.R.S. (2009). Aspectos semânticos, formais e funcionais do conceito desempenho em estudos organizacionais e estratégia: um modelo analítico (Semantic aspects, formal and functional performance of the concept in organizational studies and strategy: na analytical model), 309p, *Tese*, (Thesis). Doutorado em Administração (Doctorate in Business Administration). Programa de Pós-Graduação em Administração (Post-Graduate Program in Management, Universidade Federal do Paraná (Federal University of Parana), Curitiba, Brazil.

Mccann, J. (2004). Organizational effectiveness: changing concepts for changing environments. *Human Resource Planning*, 27, 42-50.

Mellenbergh, G.J. (1994). Generalized linear item response theory. *Psychol Bull Journal*, 15, 300-307.

Mislevy, D.J., Bock, R.D., 1990. *Bilog*: Item Analysis and Test Scoring with Binary Logistic Models [Computer Program] Scientific Software, Chicago.

Moraes, E.R. (2007). Percepções de suportes organizacional e social no trabalho como antecedentes da percepção de saúde da organização (Perceptions of organizational support and social work as antecedents of perceived health of the organization.). 113 f. Dissertação (*Dissertation*). Mestrado em Psicologia (Master Degree in Psychology)., Universidade Federal de Uberlândia (Federal University of Uberlândia), Uberlândia, Minas Gerais, Brazil.

Pennings, J.M.; Goodman, P.S.(1977). Toward a workable framework. In Goodman, P.S. & Pennings, J.M. (Eds.), *New perspectives on organizational effectiveness* (146-84). San Francisco: Jossey-Bass.

Pfeffer, J.; Salancik, G.R.(1978). *The external control of organizations*. New York: Harper & Row.

Porter, M.E. (1980). *Competitive strategy: techniques for analyzing industries and competitors*. New York: Free Press.

Porter, M.E. (1990). *Competitive advantage of nations*, New York: McMillan.

Quinn, R.E.; Rohrbaugh, J. (1983). A spatial model of effectiveness criteria: Towards a competing values approach to organizational analysis. *Management Science*, 29, p. 363-377.

R Development Core Team (2011). *R: A language and environment for statistical computing*. R Foundation. Obtido em 11 de 01 de 2011. Acessed from: www.r-project.org. Vienna, Austria.

Radner, R. (1992). Hierarchy: the economics of managing. *Journal of Economic Literature*, v. 30, n. 1, 382-415.

Rainey, H.G.; Steinbauer, P. Galloping elephants: Developing elements of a theory of effective government organizations. *Journal of Public Administration Research and Theory*, n. 9, p. 1-32, 1999.

Reckase, M.D. (1979). Unifactor latent trait models applied to multifactor tests: Results and implications. Journal of Educational Statistics, 4, 207-230.

Reckase, M.D. (1997). A linear logistic multidimensional model for dichotomous item response data. *In* W.J. van der Linden, & R.K. Hambleton (Eds.), *Handbook of modern item response theory* (p. 271–286). New York: Springer-Verlag.

Reckase, M.D. (2009). *Mutidimensional item response theory*. New York: Springer.

Reddin, W.J. (1979). *Management effectiveness*. New York. McGraw-Hill.

Reeve, B.B. (2002). An introduction to modern measurement theory. Bethesda, MD: National Cancer Institute.

Reise, S.P. Ainsworth, A.T. Haviland, M.G. (2005). Item Response Theory: Fundamentals, Applications, and Promise in Psychological Research. *Current Directions in Psychological Science*, v. 14 n. 2, 95-101.

Roos, Y. de, P. A., Meares. (1998). Application of Rasch analysis: Exploring differences in depression between African-American and White children. *Journal of Social Service Research*, 23, 3/4, 93-107.

Samejima, F.A. (1969). Estimation of latent ability using a response pattern of graded scores. *Psychometric Monograph*, 17.

Santor, D.A., Ramsay , J.O., Zuroff , D.C. (1994). Nonparametric item analyses of the Beck Depression Inventory. Examining item bias and response option weights in clinical and nonclinical samples. *Psychological Assessment*, 6, 255-270.

Seashore, S.E. (1962). *The assessment of organizational performance*. Ann, Arbor, Mich.: Survey Research Center.

Selden, S.C.; Sowa J.E. (2004). Testing a multi-dimensional model of organizational performance: prospects and problems. *Journal of Public Administration Research and Theory*. 14(3), 395-416.

Selznick, P. (1948). Foundations of the theory of organizations. *American Sociological Review*, n. 13, 25-35.

Singh, J. (2004). Tackling measurement problems with Item Response Theory: principles., characteristics, and assessment, with an illustrative example. *Journal of Business Research*, v. 57, 184-208.

Sowa, J. E.; Selden, S. C.; Sandfort, J. R. (2004). No Longer unmeasurable? A multidimensional integrated model of nonprofit organizational effectiveness. *Nonprofit and Voluntary Sector Quarterly*, vol. 33, 711-728.

Steers, R.M. (1977). Problems in the measures of organizational effectiveness. *Administrative Science Quarterly*, 20, p. 546-558.

Tavares, H.R., Andrade, D.F., Pereira, C.A.B. (2004). Detection of determinant genes and diagnostic via item response theory. *Genetics and Molecular Biology*, 27 (4), 679-685.

Tezza, R., Bornia, A. C., Andrade, D.F. de. (2011). Measuring web usability using item response theory: Principles, features and opportunities. *Interacting with Computers*, 23, 167-175.

Thibodeaux, M.S., Favilla, E. (1996). Organizational effectiveness and commitment through strategic management Industrial. *Management & Data Systems*, 96/5, 21-25.

Thissen, D., Steinberg, L. (1988). Data analysis using item response theory. *Psychological Bulletin*, 104, 385-395.

Trierweiller, A.C, Peixe, B.C.S, Bornia, A.C. ; Tezza, R., Pereira, V.L. D. do V., Pacheco Jr., W. (2011). Assessment of Organizational Effectiveness with the Use of Item Response Theory: Studies in the Department of Information Technology and Communication. *In:* XXXV Enanpad – Encontro da Associação Nacional de Pós Graduação e Pesquisa em Administração (Meeting of the National Association of Post Graduate Studies and Research in Administration). Enanpad 2011. Rio de Janeiro, Brazil.

Trierweiller, A.C., Peixe, B.C.S., Tezza, R., Bornia, A.C., Andrade, D.F.de, Campos, L.M. de S. (2012). Environmental management performance for brazilian industrials: measuring with the item response theory. Work 41, 2179-2186.

Tsui, A.S. (1990). A multiple constituency model of effectiveness: empirical examination at the human resource subunit level, *Administrative Science Quarterly*, 35, 458-483.

Van de Ven, A.H., Ferry, D.L. (1980). *Measuring and assessing organizations*, ed. Wiley, New York.

Vidotto, G., Bertolotti, G., Carone, M.F., Arpinelli, F., Bellia, V., Jones, P.W., Donner, C.F. (2006). A new questionnaire specifically designed for patients affected by chronic obstructive pulmonary disease: The Italian Health Status Questionnaire. *Respiratory Medicine*, v. 100(5), 862-870.

Weick, K.E.; Daft, R.L.(1983). *The effectiveness of interpretation systems*. *In*: Cameron, K. S.; Whetten, D.A. Organizational effectiveness. a comparison of multiple models. (71-93). New York: Academic Press.

Zimowski, M.F.; Muraki, E.; Mislev, R.J.; Bock, R.D. (1996). *BILOG-MG, multiple-grup IRT analysis and test maintenance for binary items*. Chicago: Scientific Software, Inc.