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Scale Development for Technology Resource Drivers of Competitiveness: Study of Nigerian Broadcasting Industry

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Despite the growing importance of technology management on organizational competitiveness, there is dearth of well developed research instruments to enable organizations examine the specific and generic effects of technology resource constructs on their performance. Hence, the research aims to address this gap via developing and testing instrument. Focus group analysis and extensive literature search led to the development of three technology resource and two competitiveness factors respectively. A total of 500 questionnaires were distributed to professionals across Nigerian Broadcasting Industry out of which 357 were returned. However, after removing substantially unfilled responses and morbidity cases, only 311 were considered fit for further analysis. Principal Component Factoring was run among all the proposed (20) technology resource items (Machinery 07, Manpower 06, and Method 07). KMO measure of sampling adequacy (0.920); Bartlette's tests of sphericity (0.000) anti-image correlation (0.776-0.958) support the factorability of the data. The result supports a three factor solution accounting for over 56% of the variance on technology resource. Similarly, analyses of unidimensionality, convergent, discriminant and nomological validity as well as reliability suggest the robustness of the developed scales. Finding of the study provide preliminary evidence to support the meaningfulness and appropriateness for using the three technology resource constructs in explaining the variance of organizational competitiveness not only in broadcasting industry, but also in other technology permeated industries.

1. Introduction

The importance of technology management is increasingly recognized at both private and public organizations (Ahmad, Ahmad and Nyager, 2009; Christensen, Craig, and Hart, 2001; Khalil, 2000). This progressive increase is because technology is regarded as a resource of utmost importance not only affecting organizations performance but also overall industry competitiveness (Porter, 1985; Skinner, 1985). Similarly, few industries rely on technology resources on their process of operations like the broadcasting industry. For instance, broadcasting activities involving news/information capture, processing/editing and transmission completely rely on technology resource. Key success evaluation standards in broadcasting industry such as ability to cover/present live events, uninterrupted transmission and geographic coverage of transmission, among others, all squarely rest on the quality, quantity and variety of technology resources at organizational disposal. Nigerian broadcasting industry is one of the vibrant sectors of the economy. Series of reforms suggest that private stations are increasingly encroaching upon the traditional monopoly of government owned stations.

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As highlighted, technology affects competitiveness at both macro and micro levels. On the macro level, it was observed that collective technology product improvement strategy of a country significantly affects the performance of the economy (Christensen, Craig, and Hart, 2001). Additionally, positive correlation between economic growth and telecommunications penetration was established since the 1960s through the economic theory of Gipps Curve (Nxele & Arun, 2005). At micro level, for example it was argued that internet accentuated industrial competition (Porter, 2001). Hence, technology not only affects a firm's competitive position but also overall industry structure (Porter, 1985; Skinner, 1985).

Despite this recognition, however, there is dearth of theoretically supported as well as empirically valid and reliable scales for measuring the specific technology resource drivers of competitiveness in organizations. Traditional technology management related studies are skewed towards developed countries (Ahmad et al., 2009) even though developing nations provide a different operating environment that lacks solid technology base, capacity for R&D and capital (Putranto, Stewart, Moore and Diatmoko, 2003; Sull, Ruelas-Gossi and Escobari, 2004). Thereby making the task of technology management more overwhelming (Hipkin, 2004; Pyramid Research, 2001). Thus, the overall aim of this research is to develop and evaluate exploratory scales for measuring technology resource drivers of corporate competitiveness with both theoretical and statistical support.

This approach is important in a number of ways: first, it is hope that the research will further spur academic interest in the area of developing valid and reliable scales in technology management discourse. Next, it is hoped that the research will ultimately enable academics and practitioners alike to evaluate the specific and generic technology resource drivers of competitiveness.

2. Literature Review

In management taxonomy, 'technology' takes two distinct but overlapping meanings technology resource and technology product (Ahmad & Ahmad, 2006). Zayglidoupolous (1999) described technology (resource) as the codifiable and non-codifiable information and knowledge embedded partly in the manuals and standard practices, partly in the machinery and equipment, and partly in the people and social organization of a particular organization. From the above, it is clear that technology resource has three (3) elements: *machine* (tools, structures and equipment), *manpower* (skills, expertise and knowledge) and *method* (relationship within and between manpower and machines in the process of performing both back office and frontline activities). Technology products, on the other hand, are reusable products whose consumption does not lead to their depletion (Ahmad & Ahmad, 2006). Technology product has two elements. These are tangible (TV, laptop, car) and intangible (software, GSM service, satellite signals). However, while all firms require technology resource (input), only some produce technology products as output, indicating the pervasiveness of technology resource over technology product. The three elements of technology resources can also be deduced from the fact that technology can be regarded as the theoretical and practical knowledge, skills, and artefacts that can be used to develop products and services as well as their production and delivery systems (Burgelman, Maidique & Wheelwright, 2001).

Technology resource can be viewed from the perspective of their competitive strength i.e. either effectual or ineffectual (Ahmad and Ahmad, 2006). Effectual technology resources are technology that positively impact organizational competitiveness. Effectual technology resources are further subdivided into two (2) i.e. key and auxiliary technology resources. The former refers to technology resources that sustain organisational activities. Failure/absent of key technology resources affects organizations seriously and immediately, which may, in some cases, lead to immediate disruption of activities. Auxiliary Technologies, on the other hand, are technologies that organizations need in order to outperform competitors and generally improve their back-office and front-line operations. Absence of auxiliary technologies simply means poor competitive position and does not necessarily lead to immediate disruption of corporate operations (Ahmad and Ahmad, 2006). Ineffectual technology resources are technology resources that do not add value to organization operations. They can be categorized into three (3) dimensions: quantitative (more than organizational requirement), qualitative (poor or exceptional quality below or beyond organizational need respectively) and/or variety (deploying technology type that organization has no need for).

Socio-Technical Theory (STT) is one of the theories that link organizational competitiveness to the interdependent of technology resource elements. In its simplest form, STT argued that organizations consist of two interdependent sub-systems: a social system and a technical system; and changes in one system significantly affect changes in the other (French & Ball, 1999). Accordingly, the social-sub-system comprises organizational employees as well as their knowledge, needs, interactions and commitments. The social sub-system is important given that many failures are due not to technological problems but to human lapses (Kontoghiorghes, 2005). Meanwhile, the technical sub-system of the organization consists of tools, techniques, procedures and knowledge used by organizations (Kontoghiorghes, 2005). The technical sub-system is equally important as technological advances have radically altered the nature of work, the working environment, and employee–employer relationships (Alder, Schminke, Noel, and Kuenzi, 2008, p. 481).

Task-Technology Fit (TTF) is another model that gives credence to technology resource ability to affect organizational competitiveness. TTF is viewed as the degree to which a technology (machine) assists employees (manpower) in performing their task (method) (Goodhue and Thompson, 1995). From the foregoing, we can easily substitute technology for machine, employees with manpower and performing their task by method. In other words, the fit between task and technology generally refers to match, where there is a mismatch between the task that needs to be completed and the technology available, performance will be affected (Norzaidi, Chong, Intan and Murali, 2009, p. 5).

Building on the elaborate definition of technology resource by Zayglidoupolous (1999), STT, TTF and the specific studies to be cited, the three elements are operationalized. *Machinery* element measures organizational ability to acquire and utilize the variety, quantity and quality of machineries and equipment it requires for optimal performance. The construct is measured by adequate technology to execute task, policy on replacing/disposing ageing technologies, possessing all the necessary technologies to excel, access to all the necessary machineries & equipment, sophistication of technology, obsolete/outdated, scanning the market for new machineries, guideline on the security of external (out-of-office) technologies (Ahmad et al., 2009; Baines, 2004; Hipkin, 2004). *Manpower* element measures organizational ability to attract and exploit the variety, quality and quantity of the expertise it requires for optimal performance. Manpower construct is measured by commitment to continuous training of technology-related staff, competent technical co-workers, management's knowledge of broadcasting technologies, quality/quality of staff, and availability of relevant professionals (Ahmad et al., 2009;

Hipkin, 2004; Maroney, 2007). *Method* element measures organizational ability to skilfully manage the relationship within and between machinery and manpower for optimal operation. The construct is measured by requisite internal infrastructure to accommodate new machines/expertise, encouraging champions of new technologies, clear policy on staff information sharing, technical staff safety, maintenance/repairs, creative in managing machineries & equipment (Ahmad et al., 2009; Carr, 2004; Farrell, 2003; Hamel and Skarzynski, 2001; Hipkin, 2004; Maidique and Hayes, 1984). Meanwhile the two competitiveness scales are adapted from Ahmad et al. (2009) labelled Service Delivery Capability (SDC) and Competitive Competence (CC). However, in addition to literature and theoretical support, the quality of scale development also depend on a number of multivariate analyses to test the validity of the theoretically developed scales via a process known as construct validity.

Construct validity assesses the extent to which measurement instrument correctly measures the construct it claims to measure. Traditionally, there are multiple types of validity. Nonetheless, there is a consensus toward a unified type of validity referred to as construct validity (APA, 1966; Sheperd, 1993; Stapleton, 1997) with multiple measurements yardstick (Messick, 1989). This research accepts this unified view and assesses construct validity by examining unidimensionality, factor loading, reliability, convergent validity, discriminant validity and nomological validity as suggested by Hair, Black, Babin, Anderson, and Tatham (2006) and Messick (1989), in the process relying on Factor Analysis (FA) and other multivariate instruments in line with Stapleton (1997). FA is use to uncover latent structure (dimensions) of a set of variables, accordingly it is one of the essential instrument for scales development and/or validation (Sharma, 1996). Factor analysis is used to: reduce a large number of variables to a smaller number of factors for modelling purposes, validate a scale or index by demonstrating that its constituent items load on the same factor, and drop proposed scale items which cross-load on more than one factor among others (Garson, 2007). Factor analysis can be used either for theory building or theory testing (Hair et al., 2006). Exploratory Factor Analysis (EFA) seeks to uncover the underlying structure of a relatively large set of variables. There is no prior theory and one uses factor loadings to intuit the factor structure of the data. Or Confirmatory Factor Analysis (CFA) seeks to determine whether the number of factors and the loadings of measured (indicator) variables on them conform to what is expected on the basis of pre-established theory. This research uses the two major types of EFA; PCF and Principle Axis Factoring (PAF) for construct validity (assessing unidimensionality and determining factor loading) respectively.

Similarly, unidimensionality is one of the essential elements for construct validity (Nandakumar and Ackerman, 2004; Pedhazur and Schmelkin, 1991). Strict unidimensionality indicates the presence of a single common factor whereas essential unidimensionality indicates the presence of a reasonably dominant common factor along with secondary minor dimensions (Stout, 1987 & 1990). Unidimensionality is view as the primary requirement of constructs validity as it’s a pre-condition for other categories such as reliability, convergent and discriminant validity (Mak & Sockel, 2001). All the propose constructs would be subjected to unidimensionality test via eigenvalues, % variance explained and eigenvalues ratio. Another important requirement for construct validity is the evidence of convergent validity. Convergent validity is examined by the correlation among items which make up the scale/construct. Convergent validity can be evaluated via factor loading, reliability, average variance extracted (AVE), simple factor structure, Rasch models and Common method variance (Garson, 2006; Hair et al., 2006; Straub, 1989). As mentioned earlier this research uses factor loading, reliability and factor structure to assess convergent validity. One of the key measures for convergent validity is evaluating the correlation coefficients between the variables (rows) and factors (columns) i.e. factor loading. Loadings indicate the degree of correspondence between the variable and the factor; high loadings on a factor indicate that they converge on some common point (Hair et al., 2006). Discriminant validity statistically tests whether two constructs differ. It is base on the principle that the indicators for different constructs should not be so highly correlated as to lead to the conclusion that they measure the same thing; it is one of the key yardstick for the unified construct validity. Discriminant validity is tested via a myriad of tools including correlation, factor method and AVE (Garson, 2006; Hair et al., 2006). Nomological validity measures the degree to which the summated scale makes accurate predictions of other concepts in a theoretically based model (Hair et al., 2006 p.138). Nomological validity is also considered one of the measures of construct validity, which entails establishing a theoretical and empirical consensus between distinct constructs. Hence, substantiation of nomological validity entails comparison of the correlations among the constructs and the theory. Matrix of constructs correlation would be use to assess both discriminant and nomological validity.

Reliability analysis is used to; construct reliable measurement scales, improve existing scales, or evaluate the reliability of scales already in use. There are different types of reliability such as test-retest reliability, alternative-form reliability and internal consistency reliability (Coakes, 2005; Pallant, 2001; Netemeyer, Bearden and Sharma, 2003). Test-retest reliability deals with correlation between the same measures in two different time periods (period *t* and *t+1*) in order to assess item stability other time, while alternative-form reliability estimated as based on the correlation between item 1 in period t and item 2 in period t+1, in which item 1 and 2 measure same concept. Both the aforementioned forms of reliability are appropriate for longitudinal data, since this research rely exclusively on cross-sectional data, internal consistency reliability is the most appropriate as recommended by Netemeyer et al., (2003). Internal consistency refers to the degree to which the items that make up a scale 'hang together', i.e. measuring same underlying constructs (Pallant, 2001). One of the most commonly use indicators of internal consistency is Cronbach's alpha, which is based on the average correlation of items (Coakes, 2005). In line with Huh, Delorme, and Reid (2006) and as suggested by Hair et al. (2006), internal consistency, in addition to assessing reliability, is also an indicator of convergent validity. All the proposed constructs would be subjected to test of internal consistency.

Content validity is concerned with whether the items measure the full domain implied by their label. Though derogated by some psychometricians as too subjective, content validity is an essential part of validation process, given the importance of constructs labelling in scale development and testing (Garson, 2006; Hair et al., 2006). Unidimensionality, factor loading, correlation, simple factor structure etc only indicate set of measures have convergent and discriminant validity but not what they measure. Reviewed theories/literature and FGA were used to ascertain content validity.

3. Methodological Issues

A total of 500 questionnaires were distributed to professionals across Nigerian Broadcasting Industry out of which 357 were returned; however only 311 were considered fit for further analyses after removing substantially unfilled responses and morbidity cases in line with Veal (2005). The instrument was earlier refined via Focus Group Analysis (FGA) with three (3) journalists, two (2) of which together have over fifty (50) years of experience, the third is relatively new with less than a decade of experience. The exercise helps bridge the gap between literature concepts and professionals language in scales development. Scales were based on five-point Likert scales anchored from 'strongly disagree' (1), 3 'neutral' and 'strongly agree' (5). Questionnaires were distributed across the country (Bauchi (North-east Nigeria), FCT (Central Nigeria), Kano (North-west Nigeria) and Lagos (South-west Nigeria)) with the active collaboration and assistance of a number of journalists. In the absence of existing scale explicitly measuring technology resource elements items were adopted, adapted or supported from myriad of previous studies and FGA as explained earlier. A number of multivariate statistical tools (factor and reliability analyses) were used to empirically evaluate the validity and reliability of the theoretically developed constructs. The process of data cleaning, normality assessment and sample description were explained before the finding section.

Pallant (2001) observed that a number of descriptive and graphical analyses are necessary to assess the accuracy of data file. Accordingly SPSS descriptive option was use to determine range, means and standard deviation on all variables. Appropriate procedures were subjected to categorical and continuous variables. Likewise all items that measure constructs were subjected to descriptive analysis. However, all negatively worded questions were reversed before further analysis. From the analysis, a numbers of errors in the data entry were detected by examining out-of-range values, reasonability of means and standard deviation. In keeping with best practice each individual questionnaire responses were given ID numbers making the correction easy. Hair et al. (2006) view the assumption of normality as the most fundamental assumption for all multivariate analysis. They view normality as the degree to which the distribution of sample metric data corresponds to normal distribution. Serious deviation from normality affects the statistical validity of multivariate analyses (Coakes 2005; Hair et al. 2006; Pallant, 2001). A number of descriptive statistical analyses were conducted to assess normality and identify outliers, such as Histogram, Stem-and leaf plot, Boxplot, Normality probability plot and Detrended normal plot. The boxplot was particularly useful in detecting univariate outliers. After a series of test eight (8) outliers were deleted, afterwards inspection of the boxplot revealed absent of a single outlier. Although the results of Kolmogorov-Smirnov significance shows that some constructs deviate from absolute normality, this is typical of most social science variables (Pallant, 2001) especially samples larger than 200 (Hair et al., 2006). However, an inspection of the values of Skewness and kurtosis reveals that not a single dimension reaches the ± 2 cut-off indicating serious deviation. Additionally, the difference between mean and trimmed mean for all the constructs are negligible indicating acceptable normality (Pallant, 2001).

Characteristics of Sample; Subsequent to data screening, specifically deletion of univariate outliers the sample comprised of 303 valid cases. In terms of gender, 205(68%) were found to be male and 85(28%) were female, while a token 13(4%) respondents failed to indicate their gender. Regarding the respondent's age, 19(6%) of the respondents were younger than or 17 years old; the vast majority of the respondents 191(63%) were between the age of 18 and 36; 75(25%) were individuals between 37-55 years old; and finally only 7(2%) people exceeded 55 years old, with 11(4%) not indicating their age bracket.

In terms of respondents' rank, clerks accounted for 25(8%) of the sample; officers constituted the bulk of the respondents at 205(68%); management staff made-up 28 (9%) while executive staff represented only 3(1%). A relatively high number 42(14%) did not indicate their rank. In relation to employment status a whopping 238(79%) were full-time, 34(11%) were student on industrial training. Contract staff accounted for 15(5%). Finally 16(5%) are either on 'others' or failed to indicate their status. Concerning operational sub-sector, radio station employees outnumbered (207(68%)) their TV station counterpart (74(24%)) finally 22(8%) did not indicate their sub-sectors. With regard to ownership structure of stations, government owned 240(79%) far dominated privately owned stations 43(14), a paltry 3(1%) ticked 'others' as their ownership status while 17(6%) left the option blank. Concerning respondents' department, 103(34%) are domiciled in news/current affairs section; 101(33%) were working in the programmes department; 57(19%), 18(6%) and 14(5%) were saddled with the responsibilities of managing engineering, marketing/commercials and accounts/finance departments respectively. Only 10(3%) refused to indicate their departments.

4. The Findings

This section statistically tests the validity and reliability of the five theoretically proposed scales. There are two important requirements in assessing the suitability of data for FA (i.e. constructs validity), sample size and strength of relationship among items (Tabachnick and Fidell, 1996). On the former Tabachnick and Fidell (1996, p.640) suggest "it is comforting to have at least 300 cases for factor analysis". However, with a valid sample size of 303 (after data cleaning and the subsequent deletion of univariate outliers) the sample size meets the requirement. Exploratory Factor Analysis via Principal Component Analysis (PCA) was ran to explore correlations among all the twenty (20) proposed technology resource elements items (Machinery 07, Manpower 06 and Method 07) on one hand and the thirteen (13) competitiveness items (SDC 06 and CC 07) to discover groups of related items as suggested by Lewis (2002) and Netemeyer et al (2003). The result for technology resource shows both the KMO measure of sampling adequacy (0.920) as well as significant Bartlette's tests of sphericity (0.000) met the requirement for the factorability of the data (Coakes, 2005). Similarly, anti-image correlation range from 0.776 to 0.958 also supporting the factorability of the data. With 0.862 KMO, significant Bartlette's test at 0.000 and 0.647 to 0.912 anti-image correlations, the thirteen (13) competitiveness items also satisfied the relationship requirement of running FA.

Table 1: Assessing Factorability & Number of Dimensions

Component	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
Technology Resource			
1	7.713	42.852	42.852
2	1.378	7.657	50.510
3	1.066	5.925	56.434
4	.959	5.326	61.760
18	.236	1.313	100.000
Competitiveness			
1	4.659	38.826	38.826
2	1.490	12.415	51.241
3	.947	7.888	59.130
12	.284	2.364	100.000

Extraction Method: Principal Component Analysis.

Inspection of the output supports a three factor solution for technology resource elements (after deleting two items Manpower5 and Method7) as presented in Table 1. This is because only the first three factors have an initial eigenvalues reaching one. Even though the fourth factor explained over 5% of the total variance but its eigenvalue falls short of one and inspection of the factor structure revealed only one item load 0.4 on the factor after eliminating cross-loading and negative items, as a result only three factors are retained for further analyses in line with the propose three technology resource constructs. However, the result for the thirteen competitiveness items suggests a one factor solution against the two proposed. Even though two factors emerge on the basis of eigenvalues however, *Kaiser criterion* have the tendency to severely exaggerates the true number of factors (see for example Garson 2007; Lance, Butts, & Michels, 2006). Inspection of factor structure (See Appendix A) revealed that the un-rotated matrix only has a single item on the second factor after eliminating negative and cross-loading items. On rotation via varimax, the number of valid items on the second factor increase to three. Nevertheless, when the three items were subjected to internal consistency test, the Cronbach's Alpha stood at 0.551, which is below the acceptable threshold of 0.6 (see Bagozzi & Yi, 1988 and Malhotra & Birks, 2007, p.358). Hence, a single factor solution was considered apt for overall competitiveness with nine (9) items. Consequently, the data satisfied all the guidelines for factorability and, therefore considered suitable for factor analysis.

Table 2: Indications of suitability for Factor Analysis

Constructs	KMO-MSA	BTS Sig.	Range of anti-image correlations
Machine	0.858	0.000	0.838 to 0.895
Manpower	0.770	0.000	0.723 to 0.800
Method	0.783	0.000	0.716 to 0.834
Competitiveness	0.889	0.000	0.864 to 0.919

In addition to assessing the actual number and label of the constructs accomplished via PCA, a more in-depth construct by construct analysis is conducted to confirm the validity and reliability of the four refined constructs (Machinery 07, Manpower 05, Method 06 and Competitiveness 09) via Principal Axis Factoring (PAF). Having already satisfied the sample size requirement the next step is to statistically examine the suitable of the four constructs. Inspection of table 2 revealed that all the constructs have significant Bartlette's test at 0.000, KMO range from 0.770 to 0.889, and displaying acceptable anti-image correlations, with 0.723 as the overall minimum value exceeding the 0.5 benchmark (Pallant, 2001).

Table 3: Assessing Unidimensionality

	Initial Eigenvalues				
	Component	Total	% of Variance	Cumulative %	Eigenvalues Ratio
Machinery	1	3.513	50.179	50.179	
	2	0.940	13.429	63.609	3.74
Manpower	1	2.524	50.489	50.489	
	2	0.905	18.106	68.593	2.79
Method	1	3.151	52.510	52.510	
	2	0.959	15.981	68.491	3.29
Competitiveness	1	4.511	50.123	50.123	
	2	0.843	9.363	59.486	5.35

Unidimensionality is the first logical statistical step in assessing construct validity. For the purpose of this research eigenvalues, % variance explained and eigenvalues ratio are used to assess unidimensionality. As can be seen from table 3 the second factors for all the four constructs under study falls short of 1 (Machinery 0.940, Manpower 0.905, Method 0.959 and Competitiveness 0.843). Indicating absolute unidimensionality inline with *Kaiser criterion.* On the basis of % of variance explained all the four constructs explained over 50% of the variance further supporting the suitability of one factor solutions for each. Inspection of constructs eigenvaues ratio indicated that only Competitiveness satisfied the stringent requirement of 4.0 thus indicating absolute unidimensionality (Hattie, 1985). However, the remaining three constructs also have eigenvalues ratios hovering around 3 and above indicating essential unidimensionality. Overall the four constructs exhibit absolute unidimensionality on the bases of Kaiser's criterion as well as % of variance explained. Similarly, constructs either displayed absolute unidimensionality or essential unidimensionality in terms of eigenvalue ratio. Hence all constructs satisfied unidemensionality test.

Table 4: Factor loading, Correlation and Reliability

Machinery	Factor Loading	Correlation
MA 1 Assignments without adequate technology to execute (R)	.553	Manpower .671
MA 2 Good policy for replacing/disposing ageing technologies	.630	
MA 3 Possess all the necessary technologies to excel	.808	
MA 4 Access to all the necessary machineries to carry-out task	.750	
MA 5 Obsolete/outdated machineries (R)	.562	Method .675
MA 6 Scans the market for new machineries	.610	
MA 7 Clear guidelines on the security of out-of-office technologies	.599	
Cronbach's Alpha	**α =.832**	
Manpower	Factor Loading	Correlation
MP 1 Commitment to continuous training of technology-related staff	.650	Machinery .671
MP 2 Frustrated due to lack of competent technical co-workers (R)	.408	
MP 3 Top management understanding of broadcasting technologies	.511	
MP 4 Employ top quality personnel	.649	Method .732
MP 6 Employ all the necessary professionals	.852	
Cronbach's Alpha	**α =.742**	
Method	Factor Loading	Correlation
MD 1 Requisite internal infrastructure to accommodate new technology	.651	Machinery .675
MD 2 Encourages champions of new technologies	.608	
MD 3 Clear policy on internal (among staff) information sharing	.464	
MD 4 Considers the safety of its technical staff	.767	
MD 5 Excellent policy on maintenance & repairs	.747	Manpower .732
MD 6 Very creative in managing machineries & equipment	.679	
Cronbach's Alpha	**α =.817**	
Competitiveness	Factor Loading	Correlation
CO 1 Offers wide variety of qualitative services	.625	Machinery .674
CO 2 Widen the reception of transmission	.677	
CO 3 Advertise, market and promote services	.636	
CO 4 Provide reliable services	.761	Manpower .654
CO 5 Strategic alliances & partnerships	.594	
CO 6 Improve relationship with stakeholders	.726	
CO 7 Distinctive competence	.818	Method .755
CO 8 Neutralizes advantages of competitors	.594	
CO 9 Minimize the effects of harsh operating environment	.500	
Cronbach's Alpha	**α =.872**	

Extration Method: Principal Axis Factoring
R: Reverse Items

Factor loading, reliability and factor structure were used to examine convergent validity. On the basis of factor loading all the six constructs exceeds the minimum cut-off load of 0.4 given the sample size, indicating statistical significance. Although statistically significant however, two items Manpower 2 (0.408) and Method 3 (0.464) did not meet the stringent cut-off of 0.45 and 0.50 (Bentler & Wu, 1983; Joreskog & Sorbom, 1989) and (Hair et al., 2006) respectively. This fact coupled with the importance of practical significance further justify the need for other considerations, as observed by Hair et al. (2006, p.129) “lower loadings (lower that 0.5 can be) considered significant and added to the interpretation based on other (favorable) considerations”. Consequently, reliability and simple factor structure are assessed as recommended by Hair et al. (2006) and Garson (2006). Examination of the constructs reliability indicates that all factors have good reliability suggesting good internal consistency (see Table 4) as well as a clean factor structure. Hence all the four factors exhibit good convergent validity.

Discriminant validity was evident from Table 4 as the correlations between technology resource constructs were all lower than benchmark of 0.85 (Garson, 2006). The highest correlation among the technology resource constructs is between Manpower and Method at 0.732. With regard to nomological validity, it is important to note that both STT and TTF postulate that the three dimensions of Machinery, Manpower and Method relates to each other and positively influence competitiveness. Similarly, a number of authors suggest that Method is the most important driver of competitiveness (see for example Farrell, 2003 and Maidique and Hayes, 1984). Inspection of constructs correlations presented in Table 4 supported both theoretical conclusions. First, all constructs are positively correlated and that Method relates stronger (0.755) with competitiveness, hence evidence of nomological validity.

As mentioned earlier Cronbach’s alpha coefficient is used to assess the reliability of constructs. Results of the reliability analysis presented in table 4 revealed high internal consistency, the value ranges from 0.742 for Manpower to 0.872 for competitiveness exceeding the minimal acceptable benchmark of 0.60 (Bagozzi and Yi, 1988; Malhotra & Birks, 2007) and the stringent 0.70 (Nunnally, 1978).

5. Summary and Conclusions

The foregoing analyses provide strong evidence supporting the meaningfulness and appropriateness of using the three dimensional technology resource construct in measuring competitiveness not only in broadcasting industry but also other technology permeated industries. As normality test, sampling adequacy and assessment of data factorability strongly indicate goodness of the data set for factor analysis. Consequently both statistical and theoretical analysis of unidimensionality, convergent, discriminant, and nomological validity as well as reliability supports the validity of the constructs.

Additional retesting of the scales in similar/other industries as well as other countries is highly recommended to further examine the robustness of the developed instruments across industries, countries and time. Future research should also try to test the instruments with the more rigorous Structural Equation Modelling (SEM). The high correlation between Manpower and Method even though within the acceptable value of 0.85 (Garson, 2006) have, failed to meet the stringent benchmark of 0.70 (Sekaran, 2003) indicating perhaps the need to revisit their conceptualization. Nevertheless, this research provides exploratory theoretical and empirical evidence to support the meaningfulness of using the three technology resource constructs of Machinery, Manpower and Method in explaining the variance of competitiveness in technology permeated industry.

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Appendix

Component Matrix[a]

	Component	
	1	2
CP&C3	.798	
SDC6	.773	
CP&C2	.759	
SDC5	.695	
SDC4	.695	
SDC1	.692	
CP&C4	.640	
CP&C1	.615	
CP&C7	.522	
SDC3		.696
SDC2		-.639
CP&C6	.406	.532
CP&C5	.404	.461

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

Rotated Component Matrix[a]

	Component	
	1	2
CP&C3	.803	
CP&C2	.742	
SDC6	.738	
SDC4	.736	
CP&C1	.685	
SDC1	.643	
SDC5	.629	
CP&C4	.617	
CP&C7	.589	
SDC3		.713
SDC2		-.666
CP&C6		.634
CP&C5		.567

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Reliability Statistics

Cronbach's Alpha	N of Items
.551	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
SDC3	6.7464	3.738	.301	.544
CPC5	6.5571	3.624	.378	.426
CPC6	6.3250	3.267	.410	.369