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Measuring Knowledge Workers' Productivity in the Kingdom of Saudi Arabia Telecom Industry

Dr. AbdulHafiz Jones
College Business Administration
University of Ha'il, Ha'il, KSA;

Dr. Hammad Khammes Alshammari
College Business Administration
University of Ha'il, Ha'il, KSA;

ABSTRACT

This study establishes and tests a framework for measuring knowledge workers' output in the Kingdom of Saudi Arabia (KSA) telecom industry based on the examination of capitalized labor and average revenue per user (ARPU) to measure value added intellectual coefficient (VAIC). Quarterly financial statements from 2008-2015 were used to measure an ARPU composite score of the only four publicly traded telecommunication companies on the Saudi Exchange (Tawadul). The four telecom companies comprise 32 cases which satisfied the required number of cases needed to detect a R^2 that is 50% or higher 80% of the time. A hierarchical regression was performed to measure capitalized labor (CLE), Pulic's VAIC, and its determinants' effects on ARPU composite score. The results showed a direct relationship between VAIC, its determinants, and ARPU composite score. The full model explained 78% of the ARPU composite score. CLE and CEE were significant with a combined R^2 of 29%. This study shows how ARPU is linked to functional-level strategies in telecom industry, and can be used as a KPI to measure the productivity of knowledge workers.

Keywords: ARPU, Capitalized Labor, Knowledge Workers, VAIC.

INTRODUCTION

There comes a time when an organization must rethink strategies to remain relevant in competitive markets. Commonly, an organization may achieve growth and profitability yet have trouble with new competitive and macroenvironment forces [13]. During growth and profitability period complacency or the attitude, "Don't try to fix something that isn't broken" can replace rethinking existing strategies. Contrary to this adage, Drucker stressed that the height of profitability and growth is the perfect time to take a renewed look at one's strategies [13]. The starting point for such revaluation is solid financial analysis that aims at the theory of the organization's business or how the organization makes its money.

Solid financial analysis focuses on the entire industry in which the organization operates, and goes beyond traditional financial measures such as ROE, ROA, and ROI. It includes key performance indicators (KPIs) that show links between an organization's strategies and the cost structure activities of its business model. These KPIs forecasts revenue growth based on value chain activities that creates the, productivity and efficiency necessary for a sustainable competitive advantage [41]. Contrary to traditional financial measures, KPIs have other roles that extend beyond the forecast of future revenue growth. In many instances, these KPIs are used by stakeholders to create public policy and corporate, business, and functional-level strategies respectively.

THEORETICAL BACKGROUND

ARPU: The Global KPI

Two key characteristics distinguish KPIs from traditional financial measures:

1. They are industry specific.
2. They typically measure revenue operations within an organization's cost structure.

For example, the telecom industry's common KPI is, the average revenue per user (ARPU) KPI which signals the effectiveness of strategic execution and provides a more accurate forecast than traditional financial measures when combined with revenue, cost, number of employees, or customers.

ARPU is the KPI of preference in the telecom investment community, companies, and governments globally [10,19]. The global acceptance of ARPU is due to its multifaceted functions to predict service revenue, evaluate consumer preferences, valuate spectrum capacity, compare new and existing telecom offerings, and forecast revenue [3,5,22,33,35,44,48].

ARPU is also used to determine network expansion and mediate between network and service provisioning of telecom technologies. There is an implied rule among telecom companies worldwide which applies to any expansion or deployment of advanced telecom technologies: Network capacity must exist before use. This universal rule makes it suitable for telecom companies to use ARPU to forecast the demand or adoption rate before strategic deployment of advanced technologies [48].

ARPU mediates between network and service costs, targeting the functional-level strategies of productivity and efficiency, because it also reflects the alignment between an organization's corporate, business, and functional-level strategies aimed at achieving productivity and efficiency (Kaplan & Norton, 2008). The alignment between these levels of strategy allows value creation to occur by achieving economies of scale or learning aimed at gaining a sustainable competitive advantage [23,32,41].

ARPU has a commonality with the value added intellectual coefficient (VAIC), which is an aggregation of an organization's human, structural, and employment capital that shows the overall efficiency of an organization's intellectual ability to create value [43]. The commonality between VAIC and ARPU is based on the universal rule of network capacity preceding use which translates into the cost of provisioning treated as an investment. This universal rule coincides with the concept that salary and wage expenses are treated as investments when calculating the value-added determinant of VAIC. This paper will extend the discussion on this universal rule as a building block for strategic deployment of advanced telecom technologies by capitalized labor.

Saudi Arabia's Ninth Development Plan

It is inherent in every country's economic plan to achieve full employment for its citizens, and the Kingdom of Saudi Arabia (KSA) is no different in this respect. However, the way KSA set out to aim for full employment makes it the ideal subject for this study. KSA lays out the plan for full employment in The KSA Ninth Development Plan [38], a quinquennial publication which essentially highlights the direction KSA aims to move the economy towards. The plan is a two-dimensional outline highlighting the intended use of the factors of productions within key strategic industries.

An excerpt in Chapter 10 entitled, "Manpower and Labor Markets" from the Ministry of

Economy & Planning makes the case of why KSA was selected for this study:

> *Thus, the drive towards a knowledge-based economy requires development of scientific-education and training programs, with the aim of creating "knowledge workers" through inculcation, throughout the various stages of education, with a culture of work, persistence and endurance, creativity and innovation [10]. (Section 10.3.1)*

Thus, the goal is to increase the training of the Saudi workforce to address the needs of the labor market. There is mention of the need to transition to a knowledge-based economy, with the creation of knowledge workers as the conduit to achieving this. The significant takeaway of this excerpt is the identification of scientific-education, training programs, and the inculcation of creativity and innovation as requirements needed to create knowledge workers. These requirements necessitate a work environment to deliver advanced technologies, and this is best characterized in KSA's telecom industry. From a global perspective, to deliver advanced technologies in telecommunications it requires human and structural capital acting in unison.

From a human capital viewpoint, the professionals who provide these innovative products and services must have hybrid skills such as project management, financial and business analysis, and a strong information systems foundation. The telecom industry in the KSA relies on internal software development as one of the conduits to foster convergence of these skills [15,19]. The role of internal software development is beyond the scope of this study, but the capitalization aspect is worth mentioning to support selecting the KSA telecom industry to examine the relationship between VAIC and ARPU.

Functional-Level Strategies and the Knowledge Worker

Before an in-depth critique of VAIC and ARPU, the role of strategy and the characteristics of the knowledge worker need explication to better understand the effects between ARPU and VAIC. The fundamental principles of strategy earn brief mention in the existing body of research on VAIC, only to disappear in the controversy over what VAIC measures [2, 7, 25, 39, 40, 43, 47]. The controversy surrounding VAIC stems from ambiguous results when VAIC is correlated with traditional financial measures such as ROA and ROE. Table 1 highlights a consistent pattern related to VAIC, the traditional financial measures, and the characteristics of the samples selected for analysis. To prevent this paper from slipping into the pit of VAIC ambiguity, it was categorized as a KPI confirming strategy at the functional level in a single industry.

Table 1 VAIC Mixed versus Homogenous Effects

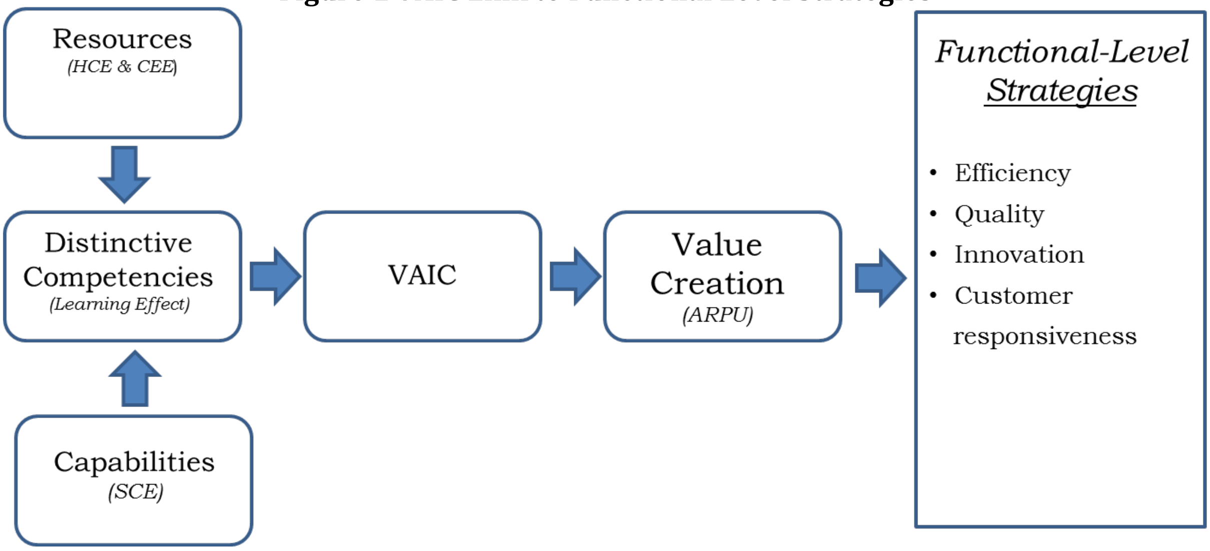
No#	Study	Sample	Dependent Variable	Independent Variable(s), Coefficients	t-statistic (Sig.)	R^2	Adj. R^2
1.	Clarke et al. (2011)	2,161 firms listed on Australian Stock Exchange from 2003 to 2008. Mixed	ROA	HCE =.210 CEE =.751 SCE =.007	11.91** 35.38** 0.439	---	.708
			ROA	VAIC $_t$ =.302 VAIC $_{t-1}$ = .214	13.03** 9.04**	---	.240
			ROE	HCE =.234, CEE =.502 SCE = .002	9.936** 17.69** 0.082	---	.478
			ROE	VAIC $_t$ =.229 VAIC $_{t-1}$ =.214	9.60** 8.36**	---	.293
2.	Calisir et al. (2010)	14 Information Technology & Communications firms on Istanbul Stock Exchange from 2005 to 2007. Homogenous	ROA	HCE=.033 LEV=.613 SZE=.177	--- --- ---	.600	---
			ROA	VAIC=.005 SZE=.068 LEV=.670	--- --- ---	.464	---
			ROE	CEE=.262 HCE=.028	--- ---	.496	---
3.	Komenic and Pokrajčić (2012)	37 multinational companies (MNCs) in Serbia from 2006 to 2008. Mixed	ROA	HCE =.338 CEE =.452 SCE =.119	4.11** 5.12** 1.40	---	.414
			ROA	HCE =.302 CEE =.476 SCE =.269	3.80** 5.60** 3.28**	---	.455
4.	Joshi et al. (2013)	11 Australian owned banks from 2006 to 2008. Homogenous	ROA	HCE =.077 CEE =.609 SCE =.238	.387 3.77** 1.26	.594	.285
5.	Chen et al. (2005)	4,254 firm years on the Taiwan Stock Exchange from 1992 to 2002. Mixed	ROA	VACA=19.34 VAHU=0.07 STVA=.129	98.73** 31.36* 5.39*	---	.842
			ROA	VAIC=.199	61.23*	---	.468
			ROE	VACA=34.31 VAHU=.169 STVA=-.027	65.07* 28.04* -0.42	---	.729
			ROA	VAIC=.396	57.73*	---	.439
6.	Javornik et al. (2012)	12,000 Slovenian companies from 1995 to 2008. Mixed	ROA	VAIC=.000 SZE=.003 LEV=-.002	1.81 12.15*** -5.26***	.013	---
			ROE	VAIC=.001 SZE=.000 LEV=.000	1.78 -0.80 -1.16	.003	---
			ROA	HCE=.000 SCE=.001 CEE=.002 SZE=.004 LEV=-.001	1.73 2.50* 3.56** 11.62 -5.25***	.017	---
			ROE	HCE=.000 SCE=.002 CEE=.135 SZE=.004 LEV=-.001	1.69 2.45* 3.65*** 3.60*** - 3.10***	.021	---

7.	Phusavat et al. (2011)	11 manufacturing firms on the Thailand Stock Exchange (SET 100) from 2006 to 2009. Homogenous	ROA	VACE=.588 VAHC=.006 STVA=-.125 InCE=-.139	6.47** 3.30*** -2.10** -1.73	.541	---
			ROE	VACE=1.311 VAHC=.010 STVA=.101 InCE=-.062	5.29** 1.88 0.62 -0.28	.541	---
8.	Rahman and Ahmed (2012)	30 companies (11 banks, 10 textiles, and 9 pharmaceutical firms) on the Dhaka Stock Exchange (DSE) between 2007 and 2008. Mixed	CSP (Change in Stock Price)	HCE =.595 CEE =.258 SCE =.051	-1.43 -3.11 1.13	.275	.191
9.	Firer and Stainbank (2003)	65 South African publicly listed companies for the 2001 fiscal year. Mixed	ROA	*L*MCAP=.113 *L*DER=-.046 *L*ATO=.299 *L*PC=.105 *L*VAIC=.415	.894 .700 2.070 .794 2.899	.326	---
10.	Firer and Williams (2003)	75 South African publicly listed companies for the 2001 fiscal year. Mixed	ROA	HCE =-.004 CEE =-.005 SCE =.261	-.023 -.291 1.674	---	.048
11.	Huei-Jen Shiu (2006)	80 Technology listed companies from 2003Annual Reports	ROA	HCE =.016 CEE =.515 SCE =-.0182 SZE =-.019 LEV = .047 ROE = .247	.870 3.25*** -1.56 -1.90* 1.29 <.0001***	---	.795

***p < .05. ** p < .01. *** p < .001.**

Functional level strategies aim to achieve productivity through efficiency, quality, innovation, or customer responsiveness [23]. Organizations set out to achieve a combination of these aims in pursuit of gaining a competitive advantage [24, 30, 36, 39, 41]. Figure 1 is a modified diagram taken from Hill and Jones to show how VAIC links to strategy at the functional-level [23]. Figure 1 extends resources and capabilities as determinants of distinctive competencies due in part to the learning effect, which simply implies there is an inverse relationship between labor productivity and cost based on the employee learning more efficient ways to work. Porter mentions this inverse learning effect with cost: "The cost of value activity can decline over time due to learning that increases its efficiency" [41]. Both Hill and Jones [23] and Porter [41] discussed this learning effect under the assumptions that knowledge work has a cost and knowledge workers who increase productivity by learning better ways to achieve efficiencies creates economies of scale.

Figure 1 VAIC Link to Functional Level Strategies



Achieving economies of scale requires the existence of knowledge work and knowledge workers inside the organization's cost structure for strategies at the corporate and business level to take root. Knowledge work is work that is productive or work that achieves productivity by efficiency, quality, innovation, or customer responsiveness. Drucker [14] and Drucker [13] characterized knowledge workers as employees who:

1. Own the means of production.
2. Consider themselves professionals.
3. Have specialized knowledge; they must have access to an organization.
4. Identify themselves by their knowledge.
5. Value learning with the sole intent of knowing their job better than anyone in their organization including their boss.
6. Believe their productivity requires that they are seen and treated as "assets" rather than "costs."

The characteristic that knowledge workers are seen and treated as assets coincide with Pulic [43] statement:

> *All the expenses for employees are part of human capital. What is new about this concept is that salaries are no longer part of the input. This means expenses related to employees are not treated as cost but represent an investment. (p.64)*

At the time of Pulic [43] article, VAIC was introduced as a new human capital concept. However, thirty-four years prior, Dr. Peter Drucker first mentioned that knowledge workers are to be seen and treated as assets rather than as costs. He mentioned this under the auspice of a foretold paradigm change within organizations that would alter the assumptions of management forever. This paradigm shift in management also debunks the argument that VAIC confuses employee cost with being an asset [2, 25].

Measuring Knowledge Workers

The most accurate way to measure the output of knowledge workers requires that organizations report employees' information on their financial statements—which potentially compromises an organization's strategic direction [16]. The was one of the arguments behind the 15-month delay by the US Securities and Exchange Commissions (SEC) in 2010 in deciding on the convergence between GAAP and IFRS or replacing GAAP with IFRS [6, 16]. An alternative, or workaround to this problem, could have been to use a proxy variable for the measure of knowledge workers' output, and regress it with a KPI that represents productivity, efficiency, quality or innovation [11, 28]. The framework for this study adopts this alternative by using VAIC's human capital determinant and ARPU as the KPI to measure knowledge workers' output.

The Relationship Between VAIC, ROA and ROE

It is almost impossible to pinpoint the number of knowledge worker in an organization, much less quantify their exact output in terms of revenue created. Traditionally, market or research analysts use the revenue per employee as an acceptable measure of employee output. A popular alternative is the Intangible Asset Monitor which require an organization's support in disclosing information that possibly compromises its strategic direction on planning [29, 49]. Contrary to both the traditional approach of revenue per employee and the Intangible Asset Monitor, VAIC represents a holistic measure of intellectual ability in an organization in terms of efficiency, without the need to identify the number of knowledge workers present.

According to Pulic [24], VAIC uses operating revenue, human labor, equipment, and structure costs to measure intellectual ability. Without the headcount of knowledge workers in the VAIC calculation, intellectual ability is measured based on converting labor and equipment costs into value represented by revenue growth. This revenue growth is generated from within an organization's cost structure. The conversion of human labor, equipment, and structure costs shows the nuts and bolts of how an organization makes its money or its theory of the business [14]. The theory of the business is premised on the link between operating revenue gained and customer value because of increased efficiencies and productivity at the functional level in the organization [28, 41]. Prior research that reinterprets ROA and ROE, using VAIC and its determinants of human capital efficiency (HCE), structural capital efficiency (SCE), and capital employed efficiency (CEE), confirm this assumption [7,30,34,40]. The knowledge worker fits into this assumption as the creator of the productivity and efficiency which leads to economies of scale by means of the learning effect [25, 41].

Based on this assumption, a high coefficient determination R^2 between VAIC and ROA or VAIC and ROE shows that a high degree of efficiency and productivity exists. However, under this same assumption, but with a low R^2 between VAIC and ROA or VAIC and ROE, can one assume efficiency and productivity are insignificant or nonexistent among all organizations in each market index or exchange? If yes, then VAIC is not a credible measure of overall efficiency. If no, then we have a new limitation of VAIC.

A New Limitation of VAIC

Limitations of VAIC in prior research questioned its ability to measure intellectual capital, the core of their argument being the VAIC calculation itself [25, 47]. Critics of VAIC first point out that Pulic [43] regulates human capital (HC) to an accounting entity on an income statement. The second point of criticism is that parts of VA, HC and structure capital (SC) vary between different industries and that it is not possible to compare capital and noncapital-intensive industries [25].

This first point of criticism mentioned is true in instances where no capitalized expenses (capex) labor from internal software development are present [15]. If capex labor costs from internal software development are part of functions performed by organizations, then the first point of criticism fails to recognize a fundamental value creation activity shown on traditional financial statements—especially in the global telecom industry, to include KSA [1,4]. Capex labor cost from internal software development is a value creation activity that reflects the conversion of human capital-intensive labor costs into assets on the balance sheet. Examples of capex labor costs from internal software development activities in the telecom industry are Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and Supply Change Management (SCM) systems implementations including organizational customizations and changes that add new functionality to existing systems. The key takeaway from capex labor costs from internal software development activities are that labor costs are capitalized with software and equipment. The labor costs are capitalized under the category of activities that automate existing manual processes or add new functionality to an existing system [15, 29].

The second point of criticism speaks to the previously mentioned questioned: If a low R^2 between VAIC and ROA or VAIC and ROE is reported, can one assume efficiencies and productivity are insignificant or nonexistent in a dataset of organizations from an entire market index or exchange? The instances from Table 1, where low R^2s between VAIC and ROA or VAIC and ROE occurred, the samples represented an entire market index of organizations across various industries. Prior studies that used an entire market index or exchange indirectly assume these organizations have the same or similar corporate, business, and functional level strategies—which is impossible.

Andriessen [2] highlights improve internal management with two key emphases: creating resource-based strategies and translating business strategies into action; the use of an entire market index to measure VAIC's association with ROA and ROE gives credence to the second point of criticism. However, the inability to compare capital- and non-capital-intensive industries further adds to the argument of a new limitation of VAIC because when an entire market index is used as a sample size to measure VAIC, it weakens the effect of functional-level strategic measures. Since VAIC is considered a value creation index, this weakness is expanded when corporate-level productivity and equity ratios such as ROA and ROE are measured against it.

VAIC is a representation of the value creation index comprised of customers, products, services, and the resources used to create the products or services [43]. In examining the VAIC to ROA and VAIC to ROE associations, clearly VAIC determinants are part of the value creation index equation that reflect cost of used resources within an organization's cost structure. However, how does ROA and ROE satisfy the other side of the value creation index equation of customers, products, and services? If we draw on the previously mentioned assumptions:

1. Realized value by customers is because of increased efficiencies and productivity at the functional level.
2. A low R^2 between VAIC and ROA or VAIC and ROE does not infer efficiencies and productivity are small or nonexistent among all the organizations in a market index.

The associations of VAIC and ROA and VAIC and ROE need a moderating effect to bridge the relationships between the value creation index, and ROA and ROE metrics. Thus, the new limitation of VAIC is:

> *When measured in terms of productivity and equity ratios such as ROA and ROE, given all organizations in a market index or exchange as a sample size, a moderating effect measuring customers' responses to the wide range of products and services in terms of revenue is needed.*

The variable or variables representing this moderating effect are beyond the scope of this study, but it makes the case for further study on this topic.

This new limitation does not take away from prior studies that examined VAIC's associations with ROA and ROE among organizations in the same industry. The tangible, intangible, and competitor interrelationships within these organizations' business units compensate for the absence of this moderating effect [40, 41]. This study removes the need of a moderating effect by examining VAIC's association with ARPU in a single industry. Furthermore, ARPU as a KPI is unanimously accepted in telecom industries globally; it can address the other side of the value creation index component comprised of customers, products and services [3, 22, 33, 44, 48].

The Seven Takeaways

There are seven takeaways from the literature presented in this paper which lays the foundation for testing the relationship between VAIC, its determinants, Capitalized Labor, and ARPU in the Telecom Industry in Saudi Arabia.

1. The aim of VAIC is to measure value creation to achieve a competitive advantage [25, 27, 30, 34, 43].
2. Functional-level strategies aim at achieving economies of scale or learning by means of efficiencies, innovations, quality, or customer responsiveness in any combination [23, 32, 39, 40].
3. Knowledge workers, as defined by their characteristics, are the architects of converting resources into value as realized by the customers [13-15, 23, 41, 43].
4. The Kingdom of Saudi Arabia's 9th Economic Development Plan aims to transform the economy of Saudi Arabia into a knowledge-based economy by creating knowledge workers [38].
5. The versatility of ARPU is evidenced by its wide used in the telecom industry as a metric for telecom policy decisions, and as a tool for forecasting service revenue, evaluating customer preferences, and comparing new and existing products and services [1, 12, 3-5, 22, 33, 44, 48].
6. Capitalized internal software development plays an important role in the telecom industry from an accounting and operations perspective. Capitalized internal software development cost is a balance sheet line item that reflects the capitalized costs of converting capital-intensive labor, software, and equipment into assets [15, 29][1]. From an operation perspective, capitalized internal software development represents expanding networks and services to deliver advanced technologies [42, 48].
7. When VAIC is measured in terms of ROA or ROE with a dataset of all organizations in a market index or exchange, it reduces prediction power [8, 9, 17, 18, 20, 26, 27, 37]. This is caused by converging strategies of organization in varying industries and the inability of productivity and equity ratios to capture the customers, product or services part of VAIC [43, 47].

Based on the underpinnings of these seven takeaways, the following hypotheses were composed to measure the intellectual capital ability of the telecom organizations in Saudi Arabia as a collective. Firm leverage and market capitalization are added as controlling variables [7, 9, 27, 46].

Measuring for effect

H1a. Human capital efficiency has a positive effect on ARPU.
H1b. Structural capital efficiency has a positive effect on ARPU.
H1c. Capitalized Labor efficiency has a positive effect on ARPU.

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[1] Capitalized internal software development costs are reported as part of an organization's assets normally sub-categorized under Property, Plant & Equipment (PP&E) as Construction in Progress (CIP) or Work in Progress (WIP).

H1d. Physical capital efficiency has a positive effect on ARPU
H2a. Intellectual Capital Efficiency has a positive effect on ARPU.
H3a. VAIC™ has a positive effect on ARPU.

Capitalized labor
H4a. Intellectual Capital Efficiency has a higher positive effect on ARPU when Capitalized Labor is included in value added.
H4b. VAIC has a higher positive effect on ARPU when Capitalized Labor is included in value added.

VAIC and ARPU vs. ROA and ROE
H5a. Intellectual Capital Efficiency has a greater coefficient determination (R2) of ARPU than ROA and ROE.
H5b. VAIC has a greater coefficient determination (R2) of ARPU than ROA and ROE.

METHODS AND DATA

Statistical Power and ARPU

This study takes the financial quarterly statements between 2008 and 2015 of Saudi Telecom (STC), Mobile Telecommunications Company Saudi Arabia (Zain), Etihad Etisalat (Mobily), and Etihad Atheeb (GO), four publicly traded companies on the Saudi Tadawul (exchange), to examine the VAIC and ARPU association. The four telecom companies comprise 32 cases which meets the required number of cases needed to detect a R^2 that is 50% or higher 80% of the time [21].[2] The data used to calculate the ARPU for the combined four telecom companies quarterly was collected from the KSA Communications and Information Technology Commission (CITC). The ARPU was calculated quarterly as:

$$\text{ARPU} = \text{Total Revenue from Sales} / \text{Total Subscribers} \qquad (1)$$

Measuring VAIC

The calculation for VAIC and its determinants was taken from Public (2004).

$$\text{VAIC} = \text{HCE} + \text{SCE} + \text{CEE} \qquad (2)$$

Where:
HCE = Human Capital Efficiency
SCE = Structural Capital Efficiency
CEE = Capital Employed Efficiency

On a granular level, calculating all three VAIC determinants, HCE, SCE, and CEE, uses value added (VA) as the basis for each input of human, structural, financial, and physical capital. VA is a key part of the VAIC calculation and represents, "how competent a company is in creating value added" [7]. Pulic [43] defines VA as:

$$\text{VA} = \text{OUT} - \text{IN}$$

Where:
OUT = Total Revenues
IN = Cost of goods or services sold

[2] Statistical power is rarely included in research for journal publications; however, it was included in this paper to highlight an equally effective alternative to selecting all companies in a market index as sample size for measuring the coefficient determination R^2 for VAIC on a given dependent variable.

In more detail, VA can be calculated as:

Operating Expenses + Salaries and Wages + Depreciation and Amortization (3)

Given the breakdown of VA, the HCE variable can be further analyzed. The calculation of HCE is VA divided by HC, whereby HC is identified on financial statements as salaries and wages.

$$HCE = VA / HC \qquad (4)$$

Structural capital (SC) represents all other costs, excluding salaries and wages and capital equipment, of doing business.

$$SC = VA - HC \quad (5)$$

The Structural Capital Efficiency (SCE) is calculated as:

$$SCE = SC / VA \ (6)$$

Capital Employed and Capitalized Labor

Capital Employed (CE) reflects the money (financial capital) and the equipment (physical capital) identified on the balance sheet as the net book value of total assets.[3] The Capital Employed Efficiency (CEE) is calculated as:

$$CEE = VA / CE \qquad (7)$$

It is important to mention that capitalized labor costs are included in this CE value,[4] but not part of the VA calculation outlined in Pulic [43]. Hypotheses *H1c*, *H4a,* and *H4b* will require that capitalized labor costs be added to the VA calculation as an another input (IN) [15].

The total of HCE and SCE represent the Intellectual Capital Efficiency coefficient (ICE) which is needed for hypotheses *H2a* and *H4a*.

$$ICE = HCE + SCE \qquad (8)$$

Capitalized Labor Inclusion into VAIC

For inclusion of capitalized labor costs, which is reported as an asset on the balance sheet, we subtracted the Construction in Progress cost (CIP) from the CE. We treated CIP as an added determinant of VAIC and recalculated all variables affected as such.

CEE is recalculated without CIP inclusion in CE.

$$CEE_{cap} = VA / (CE - CIP) \qquad (9)$$

Capitalized Labor Efficiency (CLE) is calculated in terms of VA

$$CLE = VA / CIP \qquad (10)$$

[3] Net book value of the total assets equal total assets minus total accumulated depreciation.

[4] Some capital expenditures represent assets not ready to be put in service once acquired that is construction in progress (CIP). CIP additions are assets that have not begun to depreciate, and therefore are, not a part of the VA calculation via depreciation.

ICE is recalculated to include capitalized labor which is not reported in the salaries and wages line item on the income statement.

$$ICE_{cap} = HCE + SCE + CLE \quad (11)$$

VAIC is recalculated to include capitalized labor as:

$$VAIC_{cap} = HCE + SCE + CLE + CEE_{cap} \quad (12)$$

Other Calculations

As previously mentioned, this research controlled for size and leverage effects on ARPU [7, 9, 27]. The calculations for size (SZ) and leverage (LV) are as follows:

$$SZ = Ln\ (Market\ Capitalization) \quad (13)$$

Where:
Ln represent the natural log.

$$LV = Total\ debt\ /\ Total\ Assets \quad (14)$$

The productivity and equity ratios of ROA and ROE are calculated as follows:

$$ROA = Net\ Income\ /\ Total\ Assets \quad (15)$$

$$ROE = Net\ Income\ /\ Shareholder's\ Equity \quad (16)$$

Procedures

The procedures in this research align with prior research in using multiple regressions. However, hierarchical regression was used because the focal point was the measure of knowledge workers in relation to ARPU. This research produced five hierarchical regression models. Three of the models, Tables 2, 5, and 6 included the addition of CLE. The remaining two models, Tables 3 and 4, excluded CLE. The independent variables selected were based on the correlation results, but the order of entry into the regression models was based on the established priori outlined in this research with size and leverage being the exceptions. The control variables of size and leverage were entered first to control for their effects on ARPU.

Table 2: (Model 1) ARPU = SZ + LV + HCE + SCE + CLE +CEE_{cap}

Hierarchical Step	Predictor Variables	Hypothesis or Reference
1	SZ and LV	Calisir et al., 2010; Clarke et al., 2011; Javornik & Marc, 2012; Shiu, 2006
2	HCE	H1a; Pulic, 2004
3	SCE	H1b; Pulic, 2004
4	CLE	H1c; Financial Accounting Standards Board, 1998; Hafiz, 2011
5	CEE_{cap}	H1d; Pulic, 2004

Table 3: (Model 2) ARPU = SZ + LV + ICE

Hierarchical Step	Predictor Variables	Hypothesis or Reference
1	SZ and LV	Calisir et al., 2010; Clarke et al., 2011; Javornik & Marc, 2012; Shiu, 2006
2	ICE	H2a; Pulic, 2004

Table 4: (Model 3) ARPU = Size + Leverage + VAIC

Hierarchical Step	Predictor Variables	Hypothesis or Reference
1	SZ and LV	Calisir et al., 2010; Clarke et al., 2011; Javornik & Marc, 2012; Shiu, 2006
2	VAIC	H3a; Pulic, 2004

Table 5: (Model 4) ARPU = Size + Leverage + ICE_{cap}

Hierarchical Step	Predictor Variables	Hypothesis or Reference
1	Size and Leverage	Calisir et al., 2010; Clarke et al., 2011; Javornik & Marc, 2012; Shiu, 2006
2	ICE_{cap}	H4a; Pulic, 2004; Financial Accounting Standards Board, 1998; Hafiz, 2011

Table 6: (Model 5) ARPU = Size + Leverage + $VAIC_{cap}$

Hierarchical Step	Predictor Variables	Hypothesis or Reference
1	SZ and LV	Calisir et al., 2010; Clarke et al., 2011; Javornik & Marc, 2012; Shiu, 2006
2	$VAIC_{cap}$	H4b; Financial Accounting Standards Board, 1998; Hafiz, 2011

RESULTS AND ANALYSIS

Data Preparation

As previously mentioned this study used the quarterly financial statements between 2008 and 2015 of the only four publicly traded telecommunication companies on the Saudi Exchange (Tawadul). Since the goal of this study was to present a framework for measuring knowledge workers—not to compare the VAIC between all four telecom companies—an average was taken of all factors by quarter. This process produced a sample size of 32 cases for the hierarchical regression, Pearson Correlation and ANOVA results.

Pearson Correlation and ANOVA

The Pearson Correlation results in Table 7 addressed hypotheses H4a, H4b, H5a, and H5b. For H4a we assumed a stronger effect of capitalized labor efficiency on the relationship between ICE_{cap} and ARPU than ICE and ARPU based on the accounting treatment of capitalized labor in the telecommunication industry. The ICE_{cap} and ICE correlation (r) of .77 and .63 respectively clearly indicates that ICE_{cap} has a stronger relationship with ARPU than ICE—which excludes capitalized labor from the calculation of VA.

The correlation (r) between both ICE_{cap} and $VAIC_{cap}$ is 1, and ICE and VAIC correlation (r), is also 1. This addresses H4b and shows that the correlation (r) of $VAIC_{cap}$ by default has a stronger relationship with ARPU than VAIC. Tables 4, 5, and 6 in conjunction with Table 7 confirm that $VAIC_{cap}$ had a higher coefficient determination R^2 of .63 than R2 of VAIC which is .49.

Table 7 also addressed H5a and H5b. ROE and ROA associations with ARPU shows coefficient (r) scores of .20 and .29 respectively in comparison to ICE and VAIC scores of .63 each. Furthermore, the ROE and ROA scores are not significant; therefore, no further analysis was needed with ARPU. The exclusion of ROE and ROA from further analysis was not done with size and leverage, because no research questions were developed for them. However, this same approach of exclusion was taken to address H1b–with SCE high correlation (r) of .98 with HCE, $p < .01$. The SCE positive effect on ARPU is accounted for in HCE, therefore it was excluded from the model.

Multicollinearity

The approach of removing independent variables that are highly correlated with other independent variables minimized the occurrence of multicollinearity in the results of this study [21]. In fact, none of the VAIC determinants in Table 9 had Variance Inflation Factors (VIF) above 5.3 when added to the regression model[5].

Table 8 is the ANOVA results between the regression and the residual at the entry of each VAIC determinant into the hierarchical regression model. Table 9 is the combined summary results of the hierarchical regression R^2 and change in R^2, and the ANOVA change in F ratio as each VAIC determinant was added to the hierarchical regression model. In Table 9 the change in F ratio at step two with the addition of HCE showed 7.43 with the R^2 increasing from 8% to 48% with a $p < .001$. This translates into an overall positive effect of HCE and SCE on ARPU. It also signals that 48% of the variation in ARPU output from the four companies combined is interpreted by HCE and SCE

The Coefficients

Table 4 shows the predictive variables at each step with size and leverage entered as control variables at step one. Size and leverage had no significance in the correlation and no significance in the first step of the regression. HCE was entered in step two, CLE at step three and CEE at step four. All three VAIC determinants remained significant throughout the steps with the exception being HCE in the fourth step. However, the impact of HCE in the fourth step did not translate into a change in direction and effect size. In fact, HCE contributed significantly to the regression model in step two, $F\,(1, 28) = 21.71$, $p < .001$ and accounted for 40% of the variation in ARPU. The addition of CLE to the model significantly explained another 22% of the variation in ARPU, $F\,(1, 27) = 20.69$, $p < .001$. Finally, when CEE_{cap} was added to the regression model and it significantly explained an additional 7% of the variation in ARPU, $F\,(1, 26) = 9.37$, $p < .001$. The fourth step produced the regression model:

$$ARPU = 10.06 + 3.56(Size) - 20.42(LV) + 3.90(HCE) + 16.53(CLE) + 1029(CEE_{cap}) \qquad (17)$$

Given that the model explains 78% of the variation in ARPU when all five independent variables were included the fourth step, Size, LV, and HCE were not significant. However, CLE and CEE_{cap} were significant and explained a combined 29% of the variation in ARPU. Figure 2 shows how the predicted ARPU closely matches to the actual ARPU.

[5] Hair et al.'s (1998) multicollinearity rule of thumb is independent variables that are highly correlated with each other, whereby their coefficient (*r*) is .90 or higher, should be omitted if their VIF is above 5.3.

Table 7: Pearson Correlation Matrix

Measure	*M*	*SD*	ARPU	HCE	SCE	CEE	CLE	ICE	VAIC	ICE_{cap}	CEE_{cap}	$VAIC_{cap}$	ROE	ROA	Size	LV
ARPU	205.51	31.74	1													
HCE	8.33	1.57	.625**	1												
SCE	0.88	0.02	.648**	.978**	1											
CEE	0.07	0.02	.824**	.549**	.521**	1										
CLE	2.58	0.65	.755**	.377*	.410*	.746**	1									
ICE	9.20	1.60	.625**	1.00**	.979**	.549**	.378*	1								
VAIC	9.27	1.61	.630**	1.00**	.978**	.556**	.383*	1.00**	1							
ICE_{cap}	11.78	1.94	.768**	.951**	.944**	.702**	.646**	.951**	.953**	1						
CEE_{cap}	0.07	0.02	.821**	.550**	.520**	1.00**	.734**	.550**	.557**	.699**	1					
$VAIC_{cap}$	11.85	1.95	.771**	.950**	.943**	.706**	.648**	.950**	.952**	1.00**	.703**	1				
ROE	0.04	0.02	.199	.228	.282	.086	.207	.229	.228	.258	.082	.257	1			
ROA	0.02	0.01	.285	.336	.376*	.132	.167	.337	.337	.334	.131	.333	.653	1		
Size	16.48	1.30	-.288	.025	.051	-.540**	-.423*	.025	.020	-.121	-.538**	-.124	.078	.236	1	
LV	0.60	0.07	-.012	.034	.025	.097	-.074	.034	.035	.004	.101	.004	.206	-.036	-.012	1

****. Correlation is significant at the 0.01 level (2-Tailed). *. Correlation is significant at the 0.05 level (2-Tailed). *M* = Mean. *SD* = Standard Deviation. LV = Leverage**

Table 8: ANOVA

Step	*Model*	*df*	*SS*	*MS*	*F*	*ΔF*	*Sig.*
1	Size + LV	2	2592	1296	1.31	1.31	.285
	Residual	29	28639	988			
	Total	31	31232				
2	Size + LV + HCE	3	15102	5034	8.74	7.43	.000
	Residual	28	16129	576			
	Total	31	31232				
3	Size + LV + HCE + CLE	4	22100	5525	16.34	7.60	.000
	Residual	27	9131	338			
	Total	31	31232				
4	Size + LV + HCE + CLE + CEE_{cap}	5	24520	4904	19.00	2.66	.000
	Residual	26	6711	258			
	Total	31	31232				

LV = Leverage

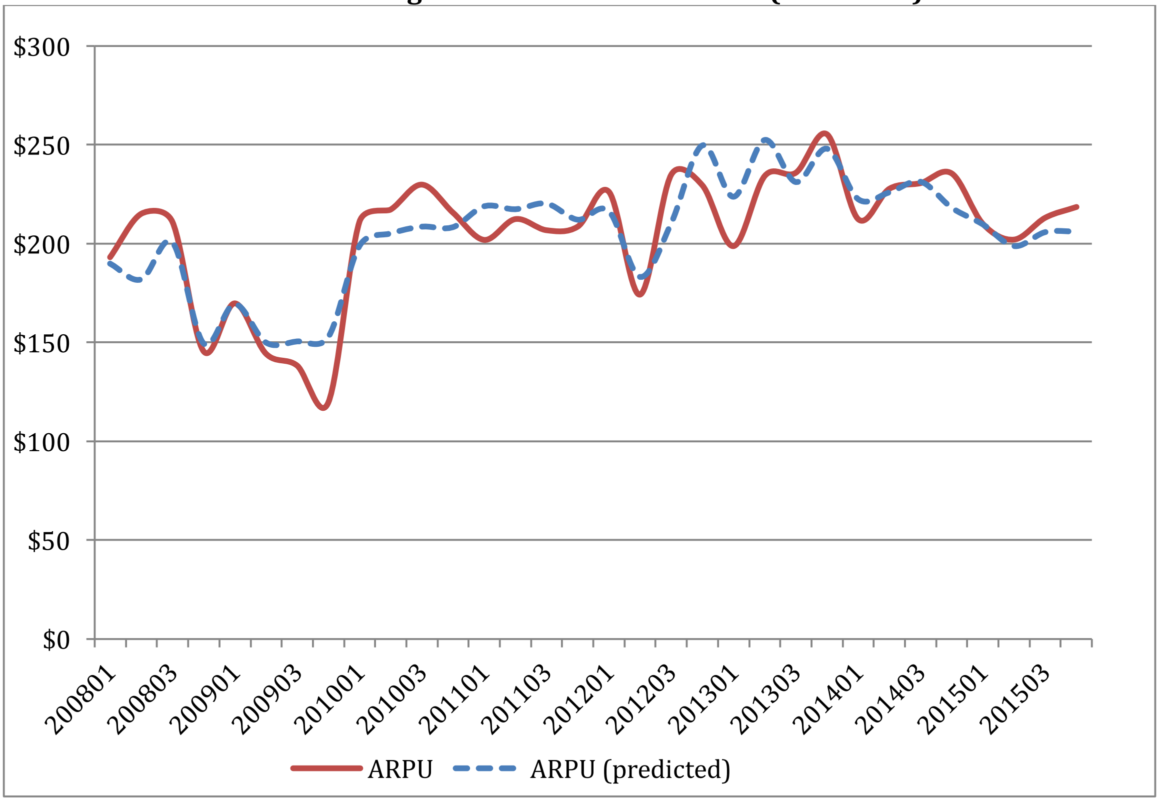
Table 9: Hierarchical Regression Model

Step and Predictor Variables	*R*	R^2	ΔR^2	ΔF	*sr*	B	β	*t*	*VIF*
Step 1:	0.29	0.08	0.08	1.31					
(Constant)						325.59			
Size					-0.29	-7.04	-0.29	-1.62	1.00
LV					-0.02	-6.75	-0.02	-0.09	1.00
Step 2:	0.70	0.48***	0.41	21.71***					
(Constant)						231.25			
Size					-0.39	-7.44	-0.30	-2.24	1.00
LV					-0.05	-16.20	-0.04	-0.28	1.00
HCE					0.66***	12.78	0.63	4.66	1.00
Step 3:	0.84	0.71***	0.22	20.69***					
(Constant)						80.43			
Size					-0.08	-1.26	-0.05	-0.44	1.29
LV					0.03	6.99	0.02	0.16	1.01
HCE					0.56**	8.19	0.41	3.51	1.23
CLE					0.66***	28.52	0.58	4.55	1.51
Step 4:	0.89	0.78***	0.07	9.37***					
(Constant)						10.06			
Size					0.23	3.56	0.15	1.20	1.78
LV					-0.10	-20.42	-0.05	-0.51	1.07
HCE					0.29	3.90	0.19	1.57	1.82
CLE					0.43*	16.53	0.34	2.45	2.28
CEE_{cap}					0.51**	1028.98	0.55	3.06	3.90

***p < .05. ** p < .01. *** p < .001. Note: sr = semi-partial correlation coefficient. LV = Leverage**

In keeping with the goal of this research, which is to measure knowledge workers, the most important predictor of ARPU was CLE. In Table 4, CLE had a partial correlation of *sr* = 43%, *t* = 2.45, *p* < .05 in the fourth step. It accounted for 22% of the variation in ARPU and a coefficient of 16.53. The CLE coefficient had such a high positive impact on the predicted ARPU that for every 1 Saudi Riyal invested in capex labor, ARPU increases by 16.53 Saudi Riyals over the combined four telecom companies.

Figure 2: ARPU versus ARPU (Predicted)



DISCUSSION AND CONCLUSION

Saudi Arabia's Transformation to a Knowledge Based Economy

KSA's *9th Economic Plan* calls for transforming its current economy to a knowledge—based economy—necessitating knowledge workers. This requirement makes it important that a framework to measure efficiency, productivity, customer responsiveness, and quality of output be established. Measuring knowledge workers' productivity in an organization is a daunting task given limited, or no access to reliable employee and job function information. In addition to scarce access, the wide variations in strategic plans adopted by organizations across an entire market index or exchange usually produce low or inconsistent results, as was shown in Table 1.

This study showed and tested a framework that overcomes the previously mentioned obstacles to measure knowledge workers based on three guiding concepts. First, VAIC and ARPU are KPIs that warrant alignment with functional-level strategies. In addition to ARPU's KPI status, it is also industry specific, applied solely in the telecom industry.

Second, the variations in strategic direction by organizations across an entire market index affect the predictive power of VAIC. VAIC is a value creation index comprised of customers, products or services, and resources. The resources are used to create both products and services, and extracted from an organization's financials. The customers, products, or services part of VAIC are addressed by way of strategic planning, implementation, and execution at the functional-level. Analyzing VAIC at the functional level and given that ROA and ROE are not measures that reflect intellectual ability in terms of customers, products, or services, explains why the low or inconsistent results shown by the prior studies in Table 1 occurred. The strategies adopted by the organizations in an entire market index, with the aim to positively affect ROA and ROE are not identical.

Finally, Drucker [13, 14] and Pulic [43] formed a consensus that knowledge workers should be seen and treated assets. This viewpoint is reflected with the inclusion of capitalized labor as an additional VAIC determinant in this study. The results of this study further support this viewpoint with capitalized labor explaining 22% of the variation of ARPU and a coefficient of 16.53. This is a clear depiction of human capital as a value creation asset—not an expense. The logical relationship between the characteristics of ARPU and knowledge workers is the link of functional-level strategies which achieve competitive advantage and aim to create productivity by way of efficiencies, innovation, customer responsiveness, and quality.

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