

# Silva's Management Competency Theory: A Factor-Item Analytic Approach Utilizing Oblique Rotation Direct Oblimin Method under Kaiser-Bartlett's Test of Sphericity

Dante L. Silva, Lilibeth D. Sabino, Dionisia M. Lanuza, Edgar M. Adina,  
Bernard S. Villaverde, Erwin G. Pena, *Member, IAENG*

**Abstract** - Classical test theory is a body of psychometric conjecture that focuses on predicting the outcomes of psychological tests, to improve their reliability and validity. Silva's Management Competency Framework Assessment Instrument (SMCF-AI) was developed, following an approach through factor-item analytic mode. The Bartlett test of sphericity was significant ( $p < .000$ ) and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was 0.84, suggesting that the data was suitable for factor analysis. The data was subjected to principal axis factoring by way of oblique rotation under direct oblimin method and the sub-scales structures were examined. The pattern Scree Plot matrix that contained information on unique contribution of the constructs to the sub-scales using the eigenvalue was used as basis for interpreting the dimensions. The eigenvalue distribution of the scree plot suggested that eight factors should be extracted. In addition, the structure matrix that takes the relationships between the factors into consideration was cross-checked if the same factors emerged. To test for covariance, a comparison of the inter-correlations between the factored scales was performed. The differences between the sub-scales across the demographic profile were analyzed using multivariate analysis of variance. The most significant contribution of this study is the development of a Silva's Management Competency Model. The empirical component of the theoretical assumption on inter-relatedness of the management competency dimensions has been supported by the results of this study captured in Silva's Management Competency Theory (IaMSilvaA).

**Index terms** - Competency Theory, Factor Analysis, Regression Analysis, Mathematical Modelling

## 1 INTRODUCTION

It is undeniable that one of the most challenging tasks that help every organization to reach its goal is putting the right person on the right job. To improve performance, the company should use the behavioral characteristics of superior performers as their "template," or "blueprint," for employee selection and development.

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Silva, Sabino, Lanuza, Adina, Villaverde and Pena are with the Mathematics Department of Mapua Institute of Technology, Intramuros Manila. The group may be contacted at +6329178951267, email: dantesilva2000@yahoo.com or at dlsilva@mapua.edu.ph.

To help find an appropriate answer in upgrading employees' performance reaching all the outstanding goals, the organization needs to develop a competency model and apply it. The competency approach provides a human resource method broadly applicable to selection, career path, performance appraisal, and development in the challenging years ahead.

Competencies are behaviors that encompass the knowledge, skills, and attributes required for successful performance. In addition to intelligence and aptitude, the underlying characteristics of a person, such as traits, habits, motives, social roles, and self-image, as well as the environment around them, enable a person to deliver superior performance in a given job, role, or situation (Hayat, M., Awan, M., Ishaq, B., & Khuram, S., 2010).

The present study aimed to provide a basic framework for human resource development for construction companies. Using this competency model, the industry could improve performance measurement and efficiency. Furthermore, this research constructs a predictive performance model through the identification of the behaviors leading to effective construction management performance.

## II. METHODOLOGY AND CONCEPTUAL FRAMEWORK

The study was both descriptive qualitative and applied quantitative, and the methodology that was utilized in this study was adopted from the well-established McBer Job Competency Assessment Process. This study developed a competency theory (IaMSilvaA) with specific foci on construction managers.

An important initial step in this research was to identify the criteria or measures that define superior or effective performance based on the meta/global competencies in the job role of construction managers. Accordingly, this research started with identifying a set of defined criteria for performance excellence specific to the construction managers management role.

Four phases were used to generate a range of performance excellence measures and these were, Phase 1: Identify Meta-Core Competencies, Phase 2: Development and Validation of the Competency Framework Phase 3: Data Collection, Analysis and Interpretation Phase 4: Theory Development and Validation.

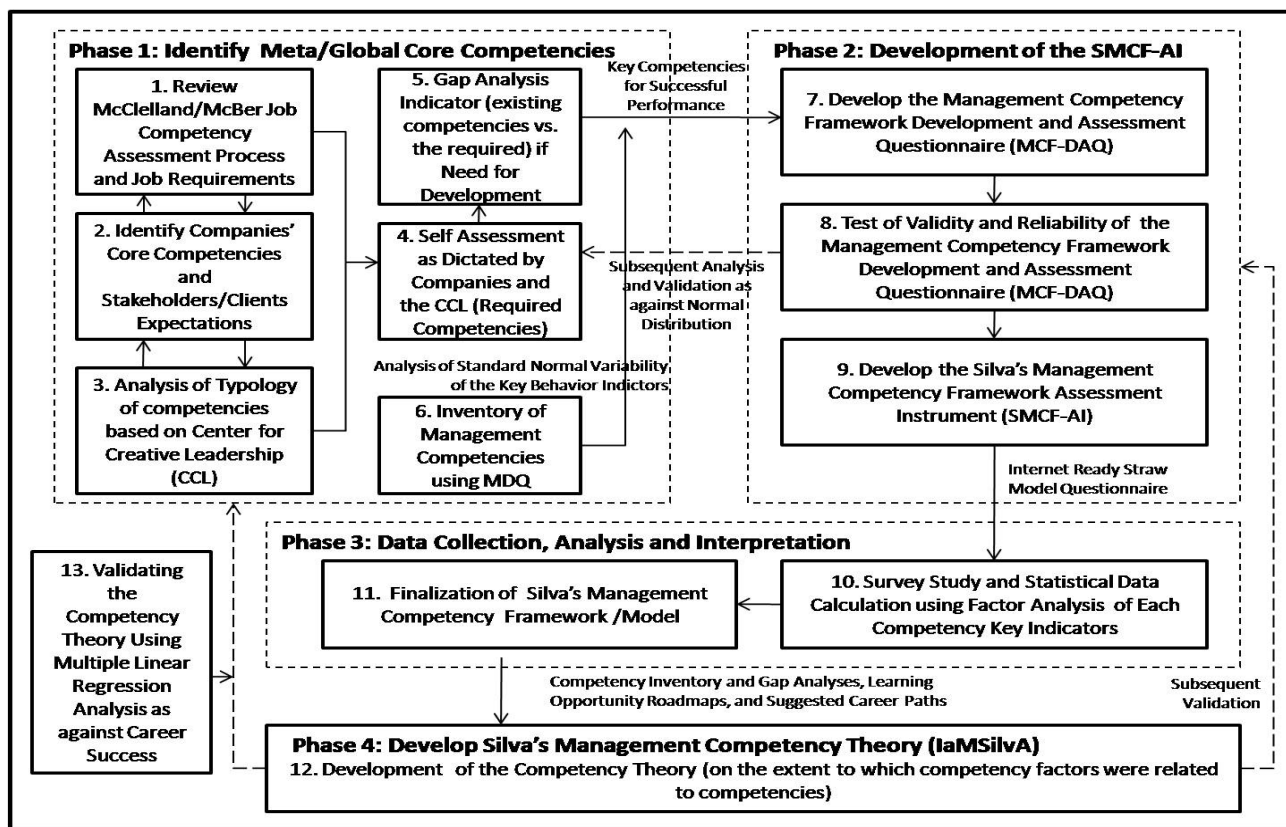


Fig 1  
 Conceptual Framework

The current research was conducted in four phases as shown in Figure 1 above.

*Phase 1: Identify Meta/Global Core Competencies*

After reviewing state of the art paradigms of competency models and after examining the different qualities of construction managers of different construction companies, the core competency factors were identified.

*Phase 2: Development of the SMCF-AI*

Developed the management competency framework development and assessment questionnaire (MCF-DAQ) based on the output of Phase 1. This phase validated the competency framework (MCF-DAQ). It was also subjected to reliability test to determine the consistency of the measurement or the degree to which the instrument measures the same way each time it was used. Based on the results of validity and reliability tests the competency framework (MCF-DAQ) was revised and now called Silva's Management Competency Framework Assessment Instrument (SMCF-AI). It was published on-line to facilitate data gathering and analysis.

*Phase 3: Data Collection, Analysis and Interpretation*

The researcher utilized respondents whose companies were members of the Philippine Contractors Association, Inc (PCA). Factor Analysis (Briggs, S. R., & Cheek, J. M., 1986) was used to finally develop the Silva's Management Competency Framework Assessment Instrument (SMCF-AI). Correlational study was used to identify the extent to which the behavioral key indicators if it is evident as against the extent of importance.

*Phase 4: Develop and Validate Silva's Management Competency Theory (IaMSilva)*

Developed the Silva's Management Competency Theory (IaMSilva), integrating all the information gathered from the different phases. The competency theory specified core competency elements for each key behaviors of performance. Multivariate analysis was used to predict career success to continuously validate the theory.

III. STATEMENT OF THE PROBLEM

The main objective of this research is to develop the Silva's Management Competency Theory (IaMSilva).

Specifically, the study sought to answer the following questions:

1. Develop a normative psychometric competence assessment instrument overarched by the clusters of meta/global competencies
2. To assess the validity and reliability of the categorization of the Management Competency Framework Development Assessment Questionnaire (MCF-DAQ) into the six competency areas.
3. To correlate the inter-relationship of the sub-scales derived from the Silva's Management Competency Framework Assessment Instrument (SMCF-AI) associated with construction managers to make generalizations about what patterns exists.
4. To develop the Silva's Management Competency Theory (IaMSilva) that will embody the empirical component of the competency framework and to

untangle the mathematical formalism and relationships into their separate patterns for interdependency and delineation.

5. Construct a logistic regression mathematical model utilizing time series multivariate analysis to predict the correlates of career success.
6. Validate the theory as predictor of career success.

#### IV. RESULTS

In light of the hypotheses and the expected structure of the Silva’s Management Competency Framework Assessment Instrument (SMCF-AI), a multi-factorial approach to the development of the framework was required. Factor analysis and item analysis were used in combination in the development process, the former to establish the factor structure underlying the items and the latter to ensure homogeneity.

The conceptualization of the Management Competency Framework Development and Assessment Questionnaire (MCF-DAQ) focused primarily on the six-fold structure suggested by the researcher based on the readings on management competencies. After an in-depth literature analysis, 6 constructs, 15 sub-constructs and 75 items were chosen to operate the six management competency constructs. Most of the items had been mentioned, either directly or indirectly in the related literature and as a result of the survey questionnaires. Items were refined to create approximately the same number of items for each of the six areas of management competency. However, a greater number initial item generation and refinement of suitable items were available for some areas, leading to some deviation in the number of items.

A review of the initial item pool by experts is an important part of scale development. The review serves multiple purposes related to maximizing the content validity of the scale (DeVellis, 1991). A pilot study was carried out (n=32), to refine the items further and to assess the suitability of the chosen survey design. This trial aimed to check the readability and unambiguity of the items, as well as the accurate recording of the data (Oppenheim, 1992). It also sought to highlight and eliminate any potential problems which subjects may encounter when answering the questions. Furthermore, piloting the questionnaire allowed for an initial assessment of the content validity of the questions and the likely reliability of the items. It can be noted that each of six management competency areas contained at least 10 items. This was considered a satisfactory number as Kline (1994) pointed out.

To get an initial idea regarding the reliability of the measure, despite the small sample size, the internal consistency of each of the six areas of management competencies was assessed (Table 1). The results indicated acceptable levels of internal consistency, above the recommended level of .70 (Tabachnick & Fidell, 2001), for all six areas: self-perception ( $\alpha=.71$ ;  $\alpha=.81$ ), authentic leadership ( $\alpha=.76$ ;  $\alpha=.82$ ), systems thinking ( $\alpha=.75$ ;  $\alpha=.71$ ), action management ( $\alpha=.81$ ;  $\alpha=.80$ ), sustainable management ( $\alpha=.82$ ;  $\alpha=.83$ ), and results orientation ( $\alpha=.77$ ;  $\alpha=.78$ ). The impact that the deletion of any of the items would have had on the value of the Cronbach alpha was assessed. It could be seen that only a couple of items would have increased Cronbach alpha by their removal, and then only negligibly.

This suggested that reliability of the measure could be expected.

Table 1  
Reliability Test of the Six Areas of Management Competency (Pilot Study)

	Cronbach Alpha (Column 1)	Cronbach Alpha (Column 2)
Self-Perception	0.71	0.81
Authentic Leadership	0.76	0.82
Systems Thinking	0.75	0.81
Action Management	0.81	0.80
Sustainable Management	0.82	0.83
Results Orientation	0.77	0.78

*\*recommended level above .70*

Apart from the development of the Silva’s Management Competency Framework Assessment Instrument (SMCF-AI), this study aimed to assess the validity of the categorization of management competencies in six overarching competency areas, as well as the positive correlation between these areas as reflected in the framework.

The first page of the survey introduced participants to the study and provided information on the structure of the survey and the questions they would be asked. Participants were guaranteed anonymity and assured that no individual data would be published, only aggregated data. It was stressed that the data would be treated confidentially and would only be used for the purposes of this study. It was also pointed out that this study focused on self-development and participants were encouraged to be as honest in their answers as possible. They were asked to answer the questions in respect to their current or latest job only.

Factor analysis was used to uncover the latent structure of a set of variables. The data was subjected to principal axis factoring using SPSS. The Bartlett test of sphericity was significant ( $p<.000$ ) and the KMO measure of sampling adequacy was .84, suggesting that the data was suitable for factor analysis. The eigenvalue distribution of the scree plot suggested that 8 factors should be extracted.

Since, the six management competency areas were claimed to be theoretically correlated, oblique rotation was chosen as the rotation method. The factors were extracted using direct oblimin rotation and the factor solutions were examined. The pattern matrix that contains information about the unique contribution of a variable to a factor was used as the basis for the interpretation of the sub-dimensions. In addition, the structure matrix that takes the relationships between the factors into consideration was consulted, to cross-check if the same factors emerged.

Table 2 indicates the variance explained by each factor. The factors were described as follows: Managing Innovation (I), Ability Knowledge and Expertise (A), Managing Change and Differences (M), Sustainable Management (S), Interpersonal and Entrepreneurial Skills (I), People Management and Authentic Leadership (L), Personal Values and Self Image (V), Achievement and Results Orientation (A).

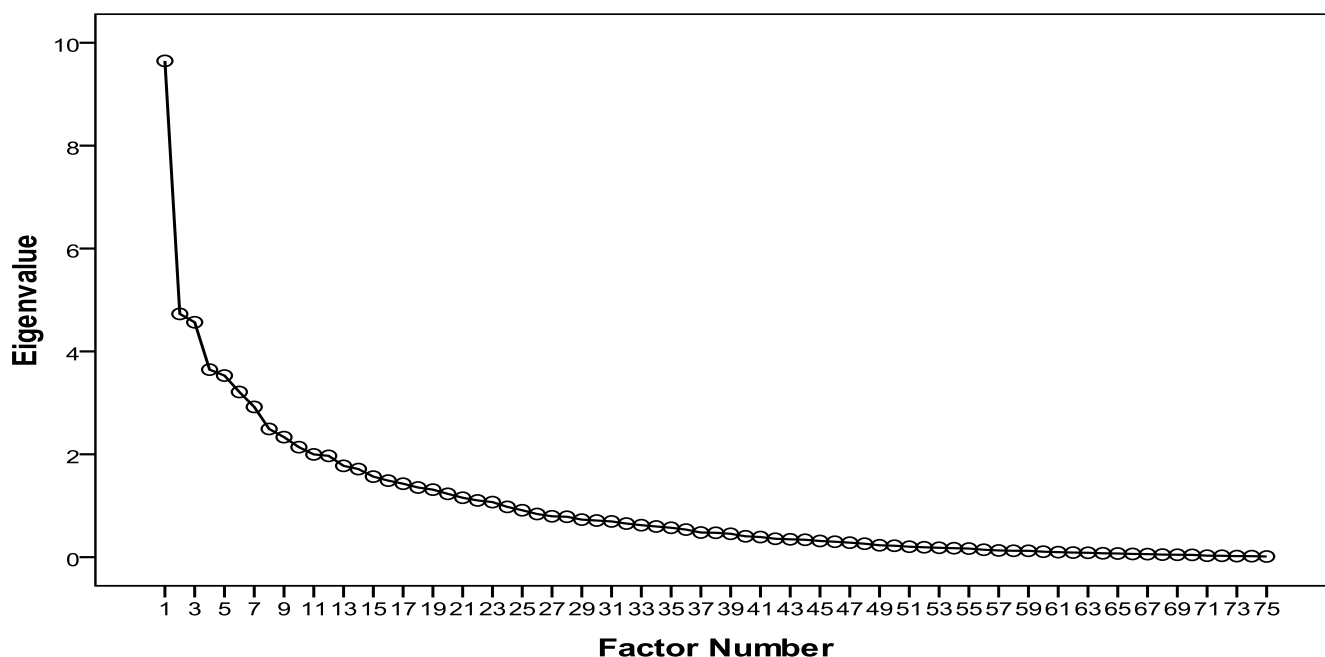


Fig 2  
 Eigenvalue Distribution of the Scree Plot

Table 2  
 Total Variance Explained by Factors

Factor	Initial Eigenvalues			Extraction Sum of Squared Loading		
	Total	% of Variance	Cumulative%	Total	% of Variance	Cumulative %
AKE	24.1	27.41	27.41	23.6	26.86	26.86
PVS	6.62	7.52	34.93	6.14	6.98	33.84
IES	4.40	5.00	39.93	3.98	4.52	38.36
PMAL	3.31	3.76	43.69	2.78	3.16	41.52
MI	2.55	2.90	46.59	2.04	2.32	43.84
MCD	2.20	2.50	49.09	1.74	1.97	45.81
SM	2.14	2.43	51.52	1.61	1.83	47.64
ARO	1.99	2.07	53.59	1.49	1.77	49.41

Extraction Method: Principal Axis Factoring

After the removal of the items, the factor analysis was run again, to ensure that the deletion of the items had not affected the factor structure (Stevens, J., 1992). The final SMCF-AI contained 48 items.

To test for covariance, a comparison of the inter-correlations between the factored scales was carried out. Table 3 shows the correlations between the sub-scales. All the sub-scales were significantly correlated. The inter-correlations between the subscales were similar, with a mean scale inter-correlation.

Table 3  
 Correlation Between the Sub-Scales (Factors)

	AKE	PMAL	IES	MCD	MI	SM	ARO
PVS	.33**	.41**	.47**	.55**	.38**	.69**	.78**
AKE		.57**	.44**	.45**	.33**	.37**	.48**
PMAL			.58**	.67**	.77**	.38**	.72**
IES				.37**	.44**	.28**	.35**
MCD					.65**	.47**	.38**
MI						.65**	.47**
SM							.71**

\*\*Correlation is significant at .01 level

To explore the sub-scales further, the overall score on the SMCF-AI was calculated as a sum of all the sub-scales divided by the number of sub-scales. The relationship between the sub-scale scores and the overall calculated management competency score was investigated using Pearson Product-Moment Correlation Coefficient. There was a strong positive correlation ( $p < .001$ ) between the sub-scales and the overall SMCF-AI score.

To analyze the relationship between SMCF-AI and career success, a standard multiple regression approach was used. After assuring that the assumptions had been met, the derived model was evaluated. The results of the model testing are presented in Table 4.

Table 4  
 Standard Multiple Regression Analysis of SMCF-AI Predicting Career Success

	JS Beta	FS Beta	HS Beta	IS Beta	LS Beta
PVS	.26**	.08	.17**	.20**	.10
AKE	.30**	.15**	.25**	.16**	.15**
PMAL	.35**	.18**	.33**	.25**	.14**
IES	.16**	.25**	.12	.03	.20**
MCD	.19**	.05	.18**	.23**	.18**
MI	.21**	.33**	.35**	.28**	.03
SM	.45**	.21**	.04	.15**	.12
ARO	.23**	.19**	.20**	.33**	.18**
R <sup>2</sup>	.25**	.15**	.18**	.20**	.12**

And the prediction equations for the standardized variables of the derived model are as follows:

$$\begin{aligned}
 Z_{JS} &= .26Z_{PVS} + .30Z_{AKE} + .35Z_{PMAL} + .16Z_{IES} + .19Z_{MCD} + .21Z_{MI} + .45Z_{SM} + .23Z_{ARO} \\
 Z_{FS} &= .08Z_{PVS} + .15Z_{AKE} + .18Z_{PMAL} + .25Z_{IES} + .05Z_{MCD} + .33Z_{MI} + .21Z_{SM} + .19Z_{ARO} \\
 Z_{HS} &= .17Z_{PVS} + .25Z_{AKE} + .33Z_{PMAL} + .12Z_{IES} + .18Z_{MCD} + .35Z_{MI} + .04Z_{SM} + .20Z_{ARO} \\
 Z_{IS} &= .20Z_{PVS} + .16Z_{AKE} + .25Z_{PMAL} + .03Z_{IES} + .23Z_{MCD} + .28Z_{MI} + .15Z_{SM} + .33Z_{ARO} \\
 Z_{LS} &= .10Z_{PVS} + .15Z_{AKE} + .14Z_{PMAL} + .20Z_{IES} + .18Z_{MCD} + .03Z_{MI} + .12Z_{SM} + .18Z_{ARO}
 \end{aligned}$$

R for all the regressions was significantly different from zero: financial success,  $F(8, 310)=4.46$ ,  $p < .01$ , job success,

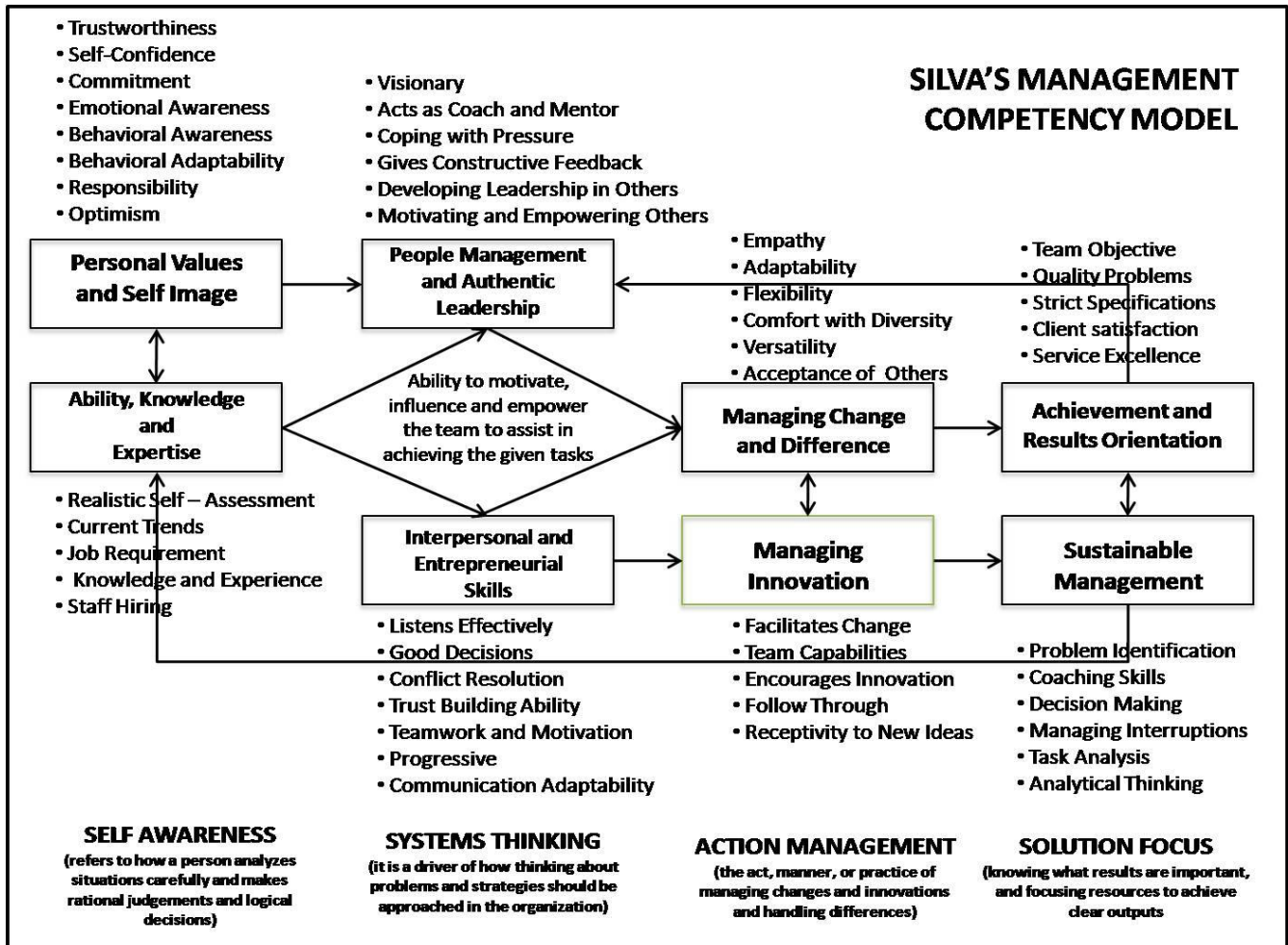


Fig 3  
 The Silva's Management Competency Model

F(8, 310)=13.64, p<.01, hierarchical success, F(8,310)=8.33, p<.01, interpersonal success, F(8, 310)=12.67, p<.01 and life success, F(8, 310)=9.64, p<.01. SMCF-AI jointly predicted 25%, 15%, 18%, 20% and 12% of the variability in job success, financial success, hierarchical success, interpersonal success and life success respectively. However, different IVs contributed significantly to the prediction of the different aspects of career success, as highlighted in Table 18. Overall, the results suggest that SMCF-AI are significant predictors (p<.01) of career success.

The study resulted in the development of the Silva's Management Competency Theory (laMSilva) reflected in the model in Figure 3. While the theory furnishes a combined pattern on the specific key competencies, it intends to serve as the scheme for human resources selection while acting as a cornerstone as to where accentuation should be put on development plans for employee competencies.

The Silva's Management Competency Theory discusses certain key competencies in management and proves them interdependent while observing patterns formed. In order to provide high standard work for clients, it is essential to have the right skills and knowledge of the fundamentals of the task at hand. It includes having the practical, technical and professional skills in the workplace, as well as keeping up with the latest trends. Furthermore, with the knowledge and skills, one should come with the integrity and commitment

and the sense of responsibility. It is a must that within the group there should be a display of accountability and optimism while also bringing in a sense of commitment and business awareness. In fact, people who have the adequate know-hows and experience feel more personally responsible for giving a high end product. While this hold true to the latter, much can also be said to people with a higher educational attainment and satisfaction. These people tend to emphasize the need for proper job skills and experience as well as producing the best product.

To finally grasp the essence of the Silva's Management Competency Theory, one must look deep on the consequences it may bring to the working atmosphere. While numerous aspects of management and leadership behavior called competencies in organizations are concurrently needed to deliver an efficient job performance, it is of great significance to delve into the interrelationship of these key components and see what patterns exist. The Silva's Management Competency Theory provides a logical template by which a plethora of core competencies are proven interdependent, and thus designates where construction project managers should place their focal points in their intricate developmental efforts. This intricate and descriptive analysis provides a collective of point of view from construction project managers through completion of a factor-item analytic analysis, and most importantly proposes to be an outline for human resources management.

### *Silva's Management Competency Theory (IaMSilva)*

Being a potent leader asserts itself as one of the readily arduous tasks of any individual atop the hierarchy. While this may hold true, honing the essential management competencies prove to be even more gruelling and of high regard, since a competent construction manager's spirit lies on his or her efficacy in a myriad of administrative aspects.

In that essence, a competent construction manager can be compelling if he/she is endowed with attributes such as regard to personal values and self-image, possession of interpersonal and entrepreneurial skills, and is accomplished with great knowledge and expertise. Furthermore, a true competent construction manager exhibits skills in people management and authentic leadership, proficient in managing innovation, susceptible to managing change and differences, performs sustainable management, and stands frontline in results orientation. However, to finally conquer the steadfast challenge of the labyrinth that is human resource selection, one must go down to the roots of management to extract the schemes that may be formed.

Through an excellently crafted self-exhibited set of personal values, an individual is apt to execute at the apex of his potential and skill. And in that light, he/she is more proficient in making well-founded ardent decisions that decide the fate of a group. In connection with having personal values and regard to self-image, this allows the individual to create lustrous relationships with his fellowmen, subordinates, superiors, and clients. Equally as important however is being knowledgeable in specific fields of studies and applications because it permits an individual to exhibit a plethora of managerial skills. While the interdependency is quite palpable, knowledge allows the individual to zero in on its particular correlation in managing change, innovation which leads to fruitful outcomes.

### V. CONCLUSION

This research paper began by carrying out an extensive literature review on the subjects of management competencies. This was followed by an in-depth examination of the literature regarding the application of these concepts in the construction site, the organizational context for this study. In light of problems with previous definitions of management competencies, a re-conceptualization of the concept was undertaken. The study involved a consultation with experts, seeking confirmation on a range of issues highlighted in the literature review.

A measure called the Silva's Management Competency Framework Assessment Instrument (SMCF-AI) was developed, following a classical test theory approach, using factor and item analytic methods. A set of concepts and representative items was selected to conceptualize the six areas of management competencies as suggested by the author. The selection employed a mainly theory-based approach, drawing on input from the literature research. An initial item pool of 75 items was retained, through consultation with subject matter experts and a small pilot trial. Responses from a large sample (n=310) were submitted to factor analyses. The results showed that instead of the expected six-fold structure, management competency comprised eight factors: Personal Values and Self-image (PVS), Ability, Knowledge and Expertise (AKE), People Management and Authentic Leadership (PMAL),

Interpersonal and Entrepreneurial Skills (IES), Managing Changes and Differences (MCD), Managing Innovation (MI), Sustainable Management (SM), and Achievement, Results Orientation (RO). Looking at homogeneity and scale length in tandem, the scales were subsequently refined and the number of items reduced to 45 items. The inter-correlations between the derived sub-scales, as well as the mean loadings of the items on the sub-scales, were significant, indicating the validity of the construct.

The Cronbach alphas for the different sub-scales were found to be of an acceptable level, above 0.7 suggesting relative stability of the derived scales. Comparing the inter-scale correlations of the SMCF-AI sub-scales with their average Cronbach alpha, the values were found to be substantially different, providing support for the discriminant validity of the construct. Furthermore, conducting a second-order factor analysis, all the sub-scales loaded above .3 on the one extracted, suggesting convergent validity.

The most significant contribution of this study is the development of a Silva's Management Competency Theory (IaMSilva). The literature review introduced a range of approaches to conceptualize the behaviors, skills and knowledge important for successful management. This study identified reliable and valid constructs, providing a means of discriminating between the ones that are indeed different and combining those that are indeed similar.

### REFERENCES

- [1] Briggs, S. R., & Cheek, J. M. (1986). The role of factor analysis in the development and evaluation of personality scales. *Journal of Personality*.
- [2] Cronbach, L. J., & Meehl, P. E. (1955). Construct Validity in Psychological Tests. *Psychological Bulletin*.
- [3] DeVellis, R. F. (1991). *Scale Development: Theory and Applications* (Vol. 26). Newbury Park: SAGE.
- [4] Hayat, M., Awan, M., Ishaq, B., & Khuram, S. (2010). Globalization and firm's quality orientation: A review of total quality management practices in manufacturing sector.
- [5] Kline, P. (1993). *The Handbook of Psychological Testing*. London: Routledge.
- [6] Kline, P. (1994). *An Easy Guide to Factor Analysis*. New York: Routledge.
- [7] Stevens, J. (1992). *Applied Multivariate Statistics for the Social Sciences*. Hillsdale: Lawrence Erlbaum Associates.
- [8] Tabachnick, B. G., & Fidell, L. S. (2001). *Using Multivariate Statistics* (4th ed.). Boston: Allyn and Bacon.
- [9] Taricone, P., & Luca, J. (2002). The Higher Education Research and Development Society of Australasia. Successful teamwork: A case study, p. 640 - 646.
- [10] Walumbwa, F. O., Avolio, B. J., Gradner, W. L., Wernsing T. S. et al. (2008). Authentic leadership: Development and validation of a theory-based measure. *Journal of Management*. p. 34,86-126.