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Modeling a reliable and valid framework for building and measuring the health system workforce's competence to lead, manage and govern in Ethiopia: Factor analysis approach

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Abstract

The purpose of this study was to model a reliable and valid framework for building and measuring health system workforce's competence to lead, manage and govern. A cross-sectional survey was conducted in three zones of Amhara regional state, northwest Ethiopia. Eight-hundred-thirteen participants were recruited from 32 health facilities. The data were collected using a structured self-rated questionnaire that comprised 26, five-point Likert scale, items. Data analysis techniques such as factor analysis, composite reliability and average variance extraction were applied. Factor analysis was unlocked to assemble the relationship among latent factors extracted, items rated and error variances observed. Latent factors were extracted using Eigenvalue greater than 1 as a cut of point. To make latent factors more meaningful, they were labeled considering the contents of the items clustered within them. Meanwhile, a framework for building and measuring competence to lead, manage and govern was modeled by assembling latent factors labeled, items rated and error variances observed. Reliability and validity of the framework were tested using composite reliability and average variance extraction analyses respectively. Four-factor framework for building and measuring the health system workforce's competence to lead, manage and govern was modeled. The four latent factors extracted were labeled as compliance with principles, strategic sensitivity, system building, and contextual thoughtfulness. These factors explained 68.434% of the total variability. Composite reliability and average variance extraction for all factors were .807 and greater, and .512 and greater, respectively. Compliance with principles, strategic sensitivity, system building, and contextual thoughtfulness are dimensions that affect competence to lead, manage and govern, which, in turn, influence the health system performance and health outcomes. This model has implications for training, evaluation, and research.

Introduction And Background

The workforce who are competent to lead, manage and govern improve the health system performance and health outcomes. [1–5] Because, it supports them to balance people's needs, workloads and organizations' requirements simultaneously. [6] Thus, a continuous deal in this area is important due to knowledge development and technological innovations. [7, 8] This deal could be also

nurtured due to the rhetoric that has been told, as the three paths are separated and reserved to a gifted group of people.

Currently, there is a promising signal that people working at all levels of the health systems look forward to building and measuring competence to lead, manage and govern. [4, 9] It is more inspiring when one sees such a signal among people working in low and middle-income countries' health systems. Usually, such ecosystems are characterized by epidemiological, economic, social, demographic, political and technological turbulences amid rising public expectations. These have sought the formulation of new designs and frameworks regarding the workforce's competence to lead, manage and govern the health systems.

As noted earlier, limited studies indicate that, the workforce who are competent to lead, manage and govern improve health outcomes. [2, 7, 10, 11] Other studies report that there is a significant duplication among the functions (practices) of the three paths. [2, 3] Such duplications might be emanated from the absence of a parsimonious and meaningful framework for building and measuring competence to lead, manage and govern.

Constructing locally validated and reliable framework in this arena has been significantly overlooked in Ethiopia that, in turn, make the health system workforce exhausted and unstable. [12] Nevertheless, this has unique importance to Ethiopia due to four fold-reasons. (i) It has an ancient vellum scriptures that have been written both in Geez and Amharic languages. (ii) It has ancient history of nation-building. (iii) There is increased decentralization and raised public expectations. (iv) This country is resource-limited. Hence, the contest and promise of this research is to bring it a burning matter in both civil services and academic spheres.

Therefore, the results of this study can enhance the policymakers', program planners', implementers' and researchers' ability to renew its framework for building and measuring competence to lead, manage and govern, in light of the indigenous ecological, social and economic realities.

Methods

Study design and participants

This study, designed to be cross-sectional, aimed at modeling a reliable and valid framework for

building and measuring competence to lead, manage and govern among the health system workforce. Eight hundred thirteen participants were included in the current study. These were the health workforce, selected from 32 healthcare organizations located in three zones of Amhara regional state, northwest Ethiopia.

Data collection

Data were collected using a structured self-rated multi-item questionnaire. Twenty-six items that had the potential to model a framework for building and measuring competence to lead, manage and govern were adapted from the Ethiopian hospital leadership, management, and governance implementation checklist; management and organizational sustainability tool; pact organizational capacity assessment tool, and the WHO health governance assessment tool. From the 26 items: ten, eight and another eight items were on leading, managing and governing practices respectively. All items were rated with a five-point Likert scale. The test stimuli (psychometric properties) of the questionnaire was refined through rigorous debriefing sessions. In this process, five specialists of health service management, of whom three were from civil service and two from the academic spheres were involved.

Data analysis

Data were entered using epi-demographic information version 7 and analyzed using statistical package for social science version 20. Different data analysis techniques such as descriptive, exploratory factor, composite reliability, and average variance extraction were employed.

Descriptive statistics was used to summarize the information about the socio-demographic characteristics of the participants, and the central tendency of the rated items.

Factor analysis was unlocked to assemble the relationship among latent factors extracted and labeled, items rated, and error variances observed. A latent factor was an unobserved variable or a theoretical construct that typically could not be directly measured, but it was assumed to cause the observed scores on the item. An item was the direct measured variable. Error variance was the portion of the factor that could not be predicted from the remaining latent factors.

About five data to model fit indices of factor analysis were tested: inter-correlation of.3 and greater;

Kaiser-Meyer-Olkin test of overall measure of sampling adequacy of.5 and greater with Bartlett's test of sphericity (P<.05); intra-item consistency of.7 and greater, total variance explained of 60% and greater and communality of.5 and greater. [13–15] The communality represented a proportion of each item's variance that had been explained by the latent factors. [14, 16]

Considering the communalities indicated, particularly at the off brackets in the last column of Table 3, two items: (i) set annual and strategic organizational plan (communality =.470), and (ii) allocate adequate resources for work (communality =.498) were violated the statistically recommended cutoff point. Accordingly, a series of factor analysis was run until all the items had a communality of.5 and greater, respecting the rule of thumb that is removing a single item with a minimum value at a time. Thus, the first iteration was done by removing set annual and strategic organizational plan. The output showed that allocate adequate resources for work again violated the rule (communality =.481). By trimming it, the second iteration was run. At this point, the outputs indicated, particularly, within the brackets in the last column of Table 3 showed that the remained items had communality.5 and greater. At this stage, the original 26-item dataset was reduced to a 24-item dataset. With this dataset, factor analysis was iterated, and another four items: (i) provide appropriate feedback to other organization members, (ii) look for best practices in the last 12 months, (iii) match deeds to words, and (iv) develop a structure that provides accountability and authority were removed due to violating the rule of complex structure. Meaning, any factor had not been resided on more than one item with factor loadings of.4 and greater. [13] It showed that the dataset that satisfied the requirements of factor analysis was reduced to a 20-item dataset.

Using this dataset, latent factors were extracted using principal axis factoring method with varimax rotation and a cut point of eigenvalue greater than 1. Meanwhile, to make the extracted factors more meaningful, they were labeled by considering the contents (scientific and empirical domains) of the items clustered within each factor. [16–18] Following this, the framework for building and measuring the health workforce's competence to lead, manage and govern was modeled by assembling latent factors labeled, items rated and error variances observed.

Finally, Composite Reliability (CR) and Average Variance Extraction (AVE) were calculated to test the reliability and validity of the framework respectively. [19, 20] Reliability was calculated from the squared sum of factor loadings divided by the squared sum of factor loadings and the sum of error variances. [21] To reaffirm the reliability, the CR was triangulated with the total variance explained. Likewise, AVE was calculated from the sum of factor loading squared divided by the sum of factor loading squared and the sum of error variances. [22] The square root of AVE was also calculated to confirm the presence of validity by comparing each value with factor correlations. The squared root value for each factor had been greater than most of the correlation coefficients of items clustered within it.

Moreover, correlations were also tested whether they were significantly different from zero, which supported the presence of convergent validity or the higher number of times that the item highly correlated within its factor compared with the items of the other factors that indicated the presence divergent validity. The percent of variability that the items shared was determined by squaring the correlations between items and multiplied by 100. The rule was that items should relate more strongly to their factor than to another factor.

Results

Basic characteristics of participants

Table 1 Basic characteristics of participants (n = 813)

Variables	Categories	Frequency	Percent
Sex	Male	417	51.3
	Female	396	48.7
Age	<= 24 years	124	15.3
	25-29 years	334	41.1
	30-34 years	256	31.5
	>34 years	99	12.2
Educational level	Diploma and less	363	44.6
	First degree	411	50.6
	Second degree and above	39	4.8
Responsibility	Head of office	61	7.5
	Process owner	35	4.3
	Unit coordinator	135	16.6
	Service owners	582	71.6
Year of service	<2 years	209	25.7
	2-4 years	222	27.3
	5-8 years	283	34.8
	>8 years	99	12.2

Indices tests

Table 2 indicates the means *($\bar{x}$)*, standard deviations (s), and correlations (r) of measuring items. The

means and standard deviations were included to show the central tendencies together with the corresponding dispersions as part of the descriptive statistics.

The inter-correlations presented on the off-diagonal part of the table ranged from.328 to.812. When each correlation was squared and multiplied by 100, it determined the percentage of variability that the respective two variables shared.

For example, when the coefficient.328 is the coefficient between item “12” (row) and item “1” (column) is squared, it becomes.108, and when multiplied by 100, it is 10.8%. This shows that the two items shared 10.8% of the variability of each other.

Table 2 Means, Standard Deviations and correlations of items (n = 813)

Item	x̄	S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	3.35	1.103	1																									
2	3.36	1.076	.679	1																								
3	3.11	1.168	.548	.644	1																							
4	3.33	1.103	.542	.619	.545	1																						
5	3.38	1.097	.540	.595	.529	.752	1																					
6	2.86	1.197	.432	.473	.563	.496	.494	1																				
7	2.97	1.214	.444	.474	.493	.547	.541	.725	1																			
8	3.25	1.161	.485	.527	.426	.591	.549	.439	.507	1																		
9	3.04	1.197	.392	.442	.472	.528	.481	.514	.504	.676	1																	
10	3.00	1.160	.387	.448	.496	.541	.506	.534	.561	.624	.716	1																
11	3.32	1.165	.413	.394	.369	.506	.523	.369	.380	.434	.455	.490	1															
12	3.04	1.172	.328	.364	.379	.416	.419	.459	.412	.434	.500	.521	.531	1														
13	3.06	1.111	.409	.414	.402	.470	.446	.491	.465	.455	.535	.523	.549	.626	1													
14	3.24	1.126	.449	.500	.456	.516	.521	.473	.467	.430	.447	.449	.531	.499	.665	1												
15	3.16	1.091	.469	.479	.424	.493	.512	.433	.430	.484	.490	.495	.541	.496	.670	.687	1											
16	3.22	1.097	.455	.459	.402	.507	.529	.406	.422	.476	.465	.470	.554	.502	.637	.673	.758	1										
17	3.20	1.136	.470	.466	.450	.537	.501	.394	.443	.455	.449	.506	.518	.402	.538	.598	.634	.657	1									
18	3.19	1.125	.453	.513	.481	.508	.507	.480	.467	.454	.452	.493	.534	.491	.584	.605	.640	.633	.713	1								
19	3.24	1.230	.428	.475	.360	.540	.510	.321	.349	.470	.393	.410	.454	.338	.413	.487	.525	.507	.580	.572	1							
20	2.95	1.171	.374	.464	.471	.466	.474	.479	.481	.379	.473	.479	.401	.412	.519	.534	.544	.551	.526	.602	.579	1						
21	2.86	1.160	.426	.487	.463	.497	.462	.495	.481	.405	.454	.486	.481	.490	.535	.537	.517	.542	.555	.613	.565	.687	1					
22	2.96	1.162	.412	.462	.407	.513	.544	.440	.503	.416	.426	.471	.490	.431	.516	.542	.546	.547	.560	.603	.564	.666	.753	1				
23	3.10	1.240	.466	.488	.427	.580	.577	.381	.435	.471	.422	.413	.506	.394	.490	.565	.531	.551	.551	.557	.580	.584	.663	.721	1			
24	2.97	1.223	.427	.460	.423	.547	.541	.446	.452	.462	.427	.447	.488	.441	.509	.556	.500	.538	.537	.615	.567	.602	.703	.720	.812	1		
25	3.07	1.284	.439	.449	.358	.558	.535	.365	.423	.477	.437	.444	.452	.353	.462	.524	.513	.518	.547	.538	.637	.532	.621	.649	.722	.731	1	
26	2.76	1.231	.388	.396	.395	.516	.501	.423	.459	.421	.439	.456	.422	.413	.444	.494	.461	.482	.505	.567	.558	.588	.657	.667	.681	.729	.756	1

Note: The numbers from 1 to 26 represented: 1 = Identify client and stakeholder needs and priorities; 2 = Recognize trends, opportunities, and risks; 3 = Look for best practices in the last 12 months; 4 = Articulate the organization's mission, strategy and vision; 5 = Determine key priorities for action; 6 = Enlist stakeholders to commit resources; 7 = Unite mobilized resources to reach organizational vision; 8 = Match deeds to words; 9 = Show trust and confidence and acknowledge contributions; 10 = Model of creativity, innovation and learning; 11 = Set annual and strategic organizational plan; 12 = Allocate adequate resources for work; 13 = Develop a structure that provide accountability and authority; 14 = Considers the organizational lines of authority for delegation; 15 = Integrate work structures and work flow; 16 = Coordinate practices with other staff's programs; 17 = Monitor their achievements against the plan, and take lessons; 18 = Provide appropriate feedback to other organization members; 19 = Uphold ethical and moral integrity to serve the public interest; 20 = Establish a consultation mechanism to heard public voice; 21 = Ensure participation of key stakeholders; 22 = Establish alliances for joint action at all levels; 23 = Oversee a shared direction to achieve organizational mission; 24 = Advocate organizational mission and vision to stakeholders; 25 = Use resources in a way that maximizes the public well-being; and 26 = Describe the outcomes related to the allocated resources.

Table 3 presents the internal consistency (alpha value) and communality of the items. The MSA for

individual items, which is displayed on the off-diagonal part of the table were.936 and greater; the overall MSA was also.962 with (P<.001).

Table 3 Internal consistencies and communalities of items (n = 813)

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	Communality
1	.960																										.571(.577)
2	-.375	.948																									.690(.704)
3	-.135	-.293	.960																								.526(.526)
4	-.002	-.143	-.068	.965																							.659(.659)
5	-.057	-.084	-.064	-.418	.961																						.622(.622)
6	-.038	.012	-.197	-.008	-.050	.936																					.566(.560)
7	-.046	.004	.032	-.081	-.073	-.504	.943																				.574(.580)
8	-.090	-.125	.083	-.093	-.046	.054	-.121	.954																			.525(.527)
9	.031	.027	-.071	-.041	.028	-.091	.039	-.364	.948																		.613(.623)
10	.076	.014	-.102	-.039	-.014	-.031	-.122	-.175	-.353	.961																	.650(.658)
11	-.071	.074	.022	-.053	-.126	.039	.034	.040	-.039	-.101	.977																.470 (-)
12	.039	-.001	-.010	.017	-.035	-.066	.027	-.042	-.055	-.108	-.185	.963															.498(-)
13	-.044	.047	.049	-.038	.086	-.062	-.017	.021	-.109	-.024	-.078	-.280	.966														.675(.624)
14	.041	-.093	-.040	-.004	-.025	-.056	-.038	.049	.020	.062	-.057	-.031	-.228	.979													.632(.633)
15	-.052	-.015	.005	.055	-.018	-.024	.041	-.036	-.025	-.030	-.026	.001	-.188	-.185	.965												.733(.757)
16	-.032	.023	.051	.003	-.082	.041	.020	-.062	.011	.036	-.069	-.059	-.079	-.144	-.365	.968											.719(.723)
17	-.080	.079	-.070	-.086	.048	.087	-.058	.034	.002	-.119	-.033	.095	.004	-.084	-.062	-.186	.963										.602(.608)
18	.037	-.104	-.041	.051	.009	-.067	.012	-.018	.047	.020	-.083	-.058	-.057	-.014	-.105	-.042	-.356	.969									.633(.635)
19	-.018	-.055	.076	-.102	-.034	.032	.097	-.132	.052	.023	-.066	.018	.079	-.002	-.074	.047	-.139	-.086	.968								.538(.531)
20	.080	-.039	-.095	.054	-.020	-.031	-.061	.126	-.119	-.039	.112	.059	-.060	-.018	-.041	-.094	.050	-.091	-.228	.967							.562(.572)
21	-.016	-.079	-.041	-.009	.159	-.102	.023	.063	-.005	-.023	-.039	-.120	-.023	.024	.062	-.035	-.038	-.023	-.066	-.205	.968						.678(.672)
22	.030	-.019	.074	.061	-.123	.059	-.127	.044	.038	-.043	-.036	.021	-.018	.021	-.066	.023	-.034	-.030	-.001	-.154	-.322	.970					.707(.706)
23	-.041	-.008	-.046	-.071	-.061	.101	-.004	-.053	-.011	.107	-.077	.044	.002	-.063	-.034	-.013	-.038	.098	-.004	-.038	-.039	-.184	.961				.740(.744)
24	.021	.029	.001	-.005	-.009	-.090	.061	-.064	.058	-.002	-.004	-.039	-.027	-.035	.098	-.018	.056	-.155	.027	-.019	-.122	-.095	-.438	.959			.769(.773)
25	-.039	-.027	.092	-.043	-.021	.043	-.009	-.029	-.035	-.026	.015	.104	-.035	-.033	-.050	-.002	-.052	.073	-.220	.091	-.035	-.026	-.140	-.170	.959		.691(.690)
26	-.017	.115	-.037	-.032	-.012	-.006	-.048	.039	-.042	-.027	.053	-.082	.070	-.010	.043	.010	.036	-.102	-.014	-.086	-.086	-.078	-.042	-.163	-.396	.964	.700(.700)

Note: - The numbers from 1 to 26 represented the same items explained in the footnote of Table 2.
-The KMO test of overall MSA with Bartlett's test of sphericity was .962 (P<.001)

Factor extraction

Table 4 displays the variance explained by the initial solution, extracted factors and rotated factors. In

all the three sections of the table, the total column reports the amount of variance, or the eigenvalue in the original items accounted for by each factor. The percent of variance column contained the percent of total variance accounted for by each factor. Finally, the cumulative percent column contained the cumulative percentage of variance accounted for by the current and preceding factors. The first section of Table 4 indicates the initial eigenvalues or the variances of the factors. For the initial solution, there were as many factors as items. In correlation analysis, items were standardized, to mean that each item had a variance of 1, and the sum of the eigenvalues equals the number of factors. Accordingly, the first four factors accounted for 68.434% of the total variance.

The second section of Table 4 presents the *extraction sums of squared loadings.*The number of rows in this section of the table correspond to the number of factors retained. In the current case, four factors were retained; thus, there were only four rows in this section of the table. The values in this section of the table were calculated in the same way as the values in the initial eigenvalue section, except that here the values were based on the common variance. These values were lower than the values in the initial eigenvalue section because they were based on common variance, which is always smaller than the total variance.

The third section of table 4 shows *rotation sums of squared loadings.* The values in this section of the table represent the distribution of the variance after rotation. The rotation maximized the variance of each of the factors, so the total amount of variance accounted for was redistributed over the four extracted factors.

For example, before rotation factor 1 accounted for considerable level of variance than the other three that is 52.612% compared to 6.596%, 5.070% and 4.156% move from factor 2 to factor 4, but when rotated, it accounted for only 20.572%, compared to 15.771%, 13.798 and 12.716% respectively.

Table 4 Total variance explained by the initial solution, extracted factors and rotated factor (n = 813)

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.679	52.612	52.612	13.316	51.214	51.214	5.349	20.572	20.572
2	1.715	6.596	59.208	1.357	5.221	56.435	4.100	15.771	36.343
3	1.318	5.070	64.278	.963	3.705	60.140	3.587	13.798	50.141
4	1.081	4.156	68.434	.706	2.717	62.857	3.306	12.716	62.857
5	.927	3.564	71.999						
6	.702	2.698	74.697						
7	.622	2.391	77.088						
8	.559	2.148	79.237						
9	.491	1.887	81.124						
10	.462	1.778	82.902						
11	.442	1.700	84.602						
12	.396	1.522	86.124						
13	.361	1.389	87.513						
14	.338	1.299	88.812						
15	.313	1.203	90.015						
16	.303	1.167	91.182						
17	.283	1.090	92.272						
18	.278	1.069	93.341						
19	.262	1.009	94.350						
20	.257	.989	95.339						
21	.241	.926	96.265						
22	.223	.858	97.123						
23	.207	.798	97.921						
24	.196	.753	98.673						
25	.187	.717	99.391						
26	.158	.609	100.000						
Note: The numbers from 1 to 26 represented the same items explained in the footnote of Table 2.									

Factor loadings

Table 5 provides factor loadings and communality values of the 20-item dataset.

Table 5 Factor loadings and communalities of items (n = 813)

Factor		1	2	3	4	Communality
1	1. Advocate organizational mission and vision to stakeholders.	.787				.775
	1. Oversee a shared direction to achieve organizational mission.	.746				.756
	1. Describe the outcomes related to the allocated resources.	.745				.694
	1. Use resources in a way	.722				.699

	that maximizes the public well-being.					
	1. Establish alliances for joint action at all levels.	.710				.709
	1. Ensure the participation of key stakeholders.	.677				.686
	1. Establish a consultation mechanism to heard public voice.	.554				.588
	1. Uphold ethical and moral integrity to serve the public interest.	.535				.536
2	1. Enlist stakeholders to commit resources.		.712			.639
	1. Unite mobilized resources to reach organizational vision.		.695			.652
	1. Model of creativity, innovation, and learning.		.624			.585
	1. Show trust and confidence and acknowledge contributions.		.577			.527
3	1. Integrate work structures			.747		.766

	and workflow.					
	1. Coordinate practices with other staff's programs.			.724		.742
	1. Considers the organizational lines of authority for delegation.			.569		.608
	1. Monitor their achievements against the plan, and take lessons.			.546		.595
4	1. Recognize trends, opportunities, and risks.				.648	.626
	1. Articulate the organization's mission, strategy, and vision.				.630	.693
	1. Identify client and stakeholder needs and priorities.				.611	.542
	1. Determine key priorities for action.				.605	.653

In the factor loadings table, unless the coefficients.4 and less were suppressed to emphasize that which factor was highly loaded on a specific item, other ways all the factors had a loading on each item. Perhaps, if each loadings was displayed, it could be supportive to check the communality of each item manually, [(14)] which was displayed in the last column of the table. Likewise, unless factor

loadings were sorted by size, other ways the table could also be presented differently.

Factor labeling

The four latent factors extracted were labeled considering the contents, scientific and empirical domains, of the items clustered within each factor. [16–18] Correspondingly, factors 1, 2, 3 and 4 were labeled as compliance with principles, strategic sensitivity, system building, and contextual thoughtfulness respectively (detailed in the discussion section).

A four-factor framework

Figure 1 indicates the four-factor framework for building and measuring the health system workforce's competence to lead, manage and govern. Observing the figure from left to right, the lines rayed from competence to lead, manage and govern denote the latent factors extracted. The lines radiated from each latent factor towards the item represent the degree of correlation of each item with the corresponding factor. The lines reflected against each item symbolize the error variance. These variances were calculated from one minus communality (values in the last column of Table 5). The higher error variance (.5 and greater) indicated that an item might not belong to any factor.

Reliability and validity test

Table 6 presents the CR, and AVE of each factor.

Table 6 CR and AVE of the factors indicated on the four-factor model (n = 813)

Parameters	Factors			
	Compliance with principles	Strategic sensitivity	System building	Contextual thoughtfulness
Sum of factor loadings	5.476	2.608	2.586	2.494
Squared sum of factor loadings	29.987	6.802	6.687	6.220
Sum of squared factor loadings	3.807	1.712	1.704	1.556
Sum of error variance	2.557	1.597	1.289	1.486
CR	.921	.810	.838	.807
AVE	.598	.517	.569	.512
√AVE	.773	.719	.775	.716
Note: Squared factor loadings and sum of error variances were calculated by using estimates indicated in Figure 1.				

Discussion

The current four-factor framework for building and measuring competence to lead, manage and govern can catch the attention of the health system authorities in low and middle-income countries. Because, the workforce who are competent to lead, manage and govern can overcome social, political, economic and technological turbulences, and improve health outcomes. [2, 7, 10, 11] This research is the pioneer to provide a comprehensive framework that explains the relationships among latent factors extracted, items rated and error variances observed. Thus, additional testing and

framework refinement, in various settings, are an important next step to provide the confidence necessary for extended application.

The scientific reliability and empirical scalability of the framework is revealed through three key actions. (i) Taking representative items from leading, managing and governing functions. (ii) Unlocking a theoretically reasonable analysis technique (factor analysis) in modeling the four-factor framework. (iii) Conducting CR and AVE to test its reliability and validity.

The four factors extracted (*Table 5)* are labeled based on the contents that the factor loadings reflect. [16–18] Accordingly, the eight items clustered within the first factor reflect compliance with organizational principles. The word compliance describes the act of acquiescing with a set of rules, and the other word principle explains an accepted rule of action. Hence, compliance with principles refers to the ability to act with an accepted set of rules. Similarly, the four items loaded within the second-factor talk about strategic sensitivity. The terms strategic and sensitivity describe mindfulness and strong attention, about mission and vision, respectively. Thus, strategic sensitivity is defined as the intensity of mindfulness and attention towards mission and vision. [23] Likewise, the other four items clustered within the third factor explain system building. System means a group of interdependent components that form a unified whole, [24] and building refers to improving interactions among the components. Consequently, system building symbolizes the ongoing process of improving interaction among the components. Compatibly, the remaining four items gathered within the last factor denote contextual thoughtfulness. The term contextual and thoughtfulness refer to the state of exploring conditions regarding the environment and deliberate thinking before doing something respectively. As a result, contextual thoughtfulness represents deliberate thinking in exploring conditions regarding the environment.

Based on the values of CR and AVE (*Table 6),*, groups of items assembled in the four-factor framework are nicely loaded. However, these values could be interpreted with important cautions. In one way, a high value for CR does not imply that the framework is unidimensional due to that CR is not a statistical test. [21] On the other way, a high AVE value does not tell solely that the variance is due to

the construct. [19, 20, 22, 25] Thus, the CR values could be supported by the total variance explained that reaffirms the unidimensionality of the model when the total variance for the first factor is quite larger than the next factor. Besides, the AVE values need a triangulation with the correlation coefficients. Convergent validity implies that all within-construct correlations are significantly different from zero and of approximately the same magnitude. Divergent validity is satisfied if the cross-correlations are high, uniform and lower than the within-construct correlations.

The possible limitation of the current study is related to the level of analysis. This framework modeling was conducted at the individual level since the variables were measured at the individual level.

Conclusions

Compliance with principles, strategic sensitivity, system building, and contextual thoughtfulness are core dimensions that affect competence to lead, manage and govern. These, in turn, influence the health system performance and health outcomes. The proposed model can provide foundations for future training, evaluation, and research. Feature research needs to examine the framework at both individual and organizational levels.

Declarations

Acknowledgments

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Disclosure

All the authors declare that they have no competing interests.

Ethical clearance with a protocol record 090/18–04 was secured from Bahir Dar University (BDU). Each participant provided consent, and end-to-end anonymous response was kept.

This work is an extension of our previous work which can be also be found as a preprint:

https://www.researchsquare.com/article/4df53cb7-c432–4e8b-a7fb-a70613562278/latest

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Figures

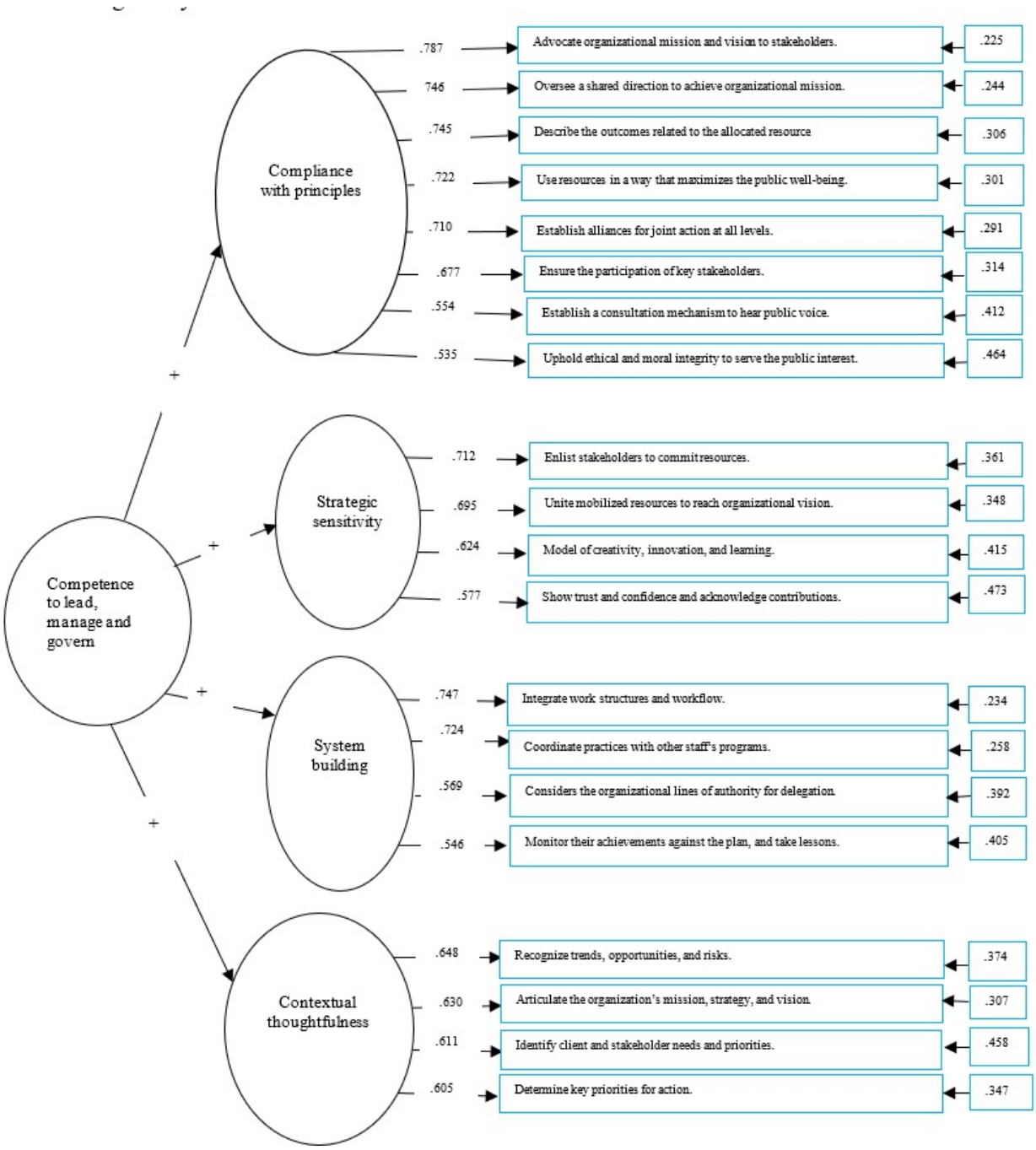

Figure 1

Framework for building and measuring competence to lead, manage and govern