Managing Scientific Collaborations for a Meaningful Added – Value: Real Concern Between Strategy Resilient Development and its Financial Implementation

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Abstract

The purpose of this research was to investigate possible factors that create major barriers in the field of scientific collaboration management at higher education level. Through a new validated questionnaire that includes the opinions of a variety of research collaborators and alike positions at different Saudi universities, the author argues the emergence of two interesting contradictory factors. A positive and significant effect of funding opportunities, but a lack of a significant strategy development that is planned around resilience. In addition, benchmarking analysis with elite institutions showed significant divergent across the collaboration spectrum. New studies in this area built on the present findings, may explore a balance between the strategy development and its financial implementation from different perspectives to get meaningful results that add real values and secure long – term sustainability.

Keywords: *Scientific Collaborations, Strategy Development, Added - value, Sustainability, GLM Estimation.*

Introduction

The purpose of this research was to investigate empirically scientific collaboration amid disruption in Saudi higher education. This investigation is not designed as a collaboration strategy for particular subjects, or geographic regions. Instead, it seeks the keys success that can be used to develop resilient strategies that converge towards maximizing impacts on scientific collaboration. The context of collaboration seeks also to support the Ministry of Education (ME) ambitious goal in improving the international ranking of educational institutions outlined in Vision 2030. In this context, the ME has pledged its commitment to provide support to universities, with respect to strategic planning, as well as in providing any data and report studies that deem to be relevant. The ME has insisted also on the need of private sector support in the financing and construction of education infrastructure, creating new opportunities for foreign investors.

Scientific knowledge collaboration is widely recognized in the literature as finding challenging solutions to many barriers that affect the institution's advancement. Such solutions cannot be achieved from internal stakeholders alone. At higher education level, the need of international scientific collaboration has been well – established in enhancing institution international profile and contributing to world knowledge and discovery

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(Woolf; 2010; Altbach et al., 2009). However, institutions managing these collaborations require real commitment from partners, effective communication, and a transparent strategy to achieve shared outcomes (Zahner, 2005; Perkins et al. 2011; Jones and Barry, 2011b; Cramm et al. 2013). In general, these outcomes are very challenging to meet due to differences in resources, talent, and culture (Sachs et al., 2019; Eckboir et al., 2016).

In addition, collaboration is considered as a nested phenomenon with inter connected layers that exists simultaneously within the larger community (Geurts, et al., 2022; Woodland and Hutton, 2012; Vangen and Huxham, 2003). Hence, evaluators should possess the rights skills and mindsets to develop a collaboration strategy that is resilient and sustainable. Such collaboration involves inter-collaborations (departments, units, colleges, centers, etc.), intra-collaborations with peers, and non – academic collaborations (government, national private organizations, multinational organizations, public offices, international cooperation agencies, etc.).

Another interesting feature of scientific collaboration is that it creates added value in long – term. The nature of this value depends on shared goals established during the collaboration process (Della Corte and Del Gaudio, 2014; Kang et al., 2007; Lepak, Smith and Taylor, 2007). This a challenging issue for shareholders in a very complex institution to achieve a set of values at the same time and hence, it's beyond the focus of this study. That's said, value creation is treated as a whole dimension and does not explicitly define which one is targeted.

The study was performed as follow: (i) An empirical analysis of a questionnaire that includes the opinions of a variety of research collaborators and alike positions at different Saudi universities, chosen from Times Higher Education rankings list (THEs). This analysis involves a validity of the questionnaire, followed by an ordered outcomes estimation of the defined model. The estimation values of the marginal effects and their respective significances are also analyzed. (ii) A benchmarking analysis with top ranking list that was published by THEs. The purpose of this analysis is to support the ME goals in enhancing international ranking for Saudi's universities. The criteria chosen for benchmarking are research environment, research quality, industry, and international outlook. And, (iii) discuss the significance of the study results and their implications to decision making policy seeking new concepts and practices to achieve a meaningful value at international level.

Methods

The data analyzed in this study were obtained from a new questionnaire that includes the opinions of a variety of research collaborators and alike positions at different Saudi universities retrieved from THEs league Table (November 2023). This Table includes 2 private universities and 20 public universities. If we assume that each university has in the average 30 research collaborators, then the total sample population (N) was 660. By using Richard Geiger equation, the computed sample size was 243 participants, with a margin of error set at 5%, and a confidence level of 95%. After questionnaire submission, a total of 205 responses were obtained with a response rate of 80% (n = 205).

The dependent variable is a single measure and an ordered choice. Respondents were asked to rate on a 4-point scale (1 = very poor to 4 = excellent) the following statement: "The management of scientific collaborations adds a meaningful value to the university." But the independent variables are classified into five dimensions: Strategy Resilient Development (5 items, Dimension1), International Collaboration with Peers (4 items, Dimension2), Collaboration with Non-academic Sector (4 items, Dimension 3), Increasing Funding Rate (4 items, Dimension 4), and Digital Opportunities for Competitive Advantage (4 items, Dimension 5). All respondents were asked to rate on a 4-point scale (1 = strongly disagree to 4 = strongly agree). In addition, one variable was

used as a dummy variable university autonomy (1 = if the university is autonomous and 0 = otherwise).

Statistics descriptive analysis for all variables was performed via "IBM SPSS Statistics version 23." For the questionnaire validity, the study used the internal reliability consistency of each dimension (Cronbach coefficient, α>0.70 and the construct validity (Pearson correlation coefficients, ρ>0.30). while for the quantitative analysis, generalized ordered logit model regression (GLM) is chosen since it outperforms the linear regression model (Khedhiri, 2018).

Results Discussion and Implications

Descriptive statistics for all variables are displayed in Table 1. It's worth noting that around 80% of respondents agree on the management of scientific collaborations adding a meaningful value to the university, and only 10% considers their university as autonomous. The reliability of all dimensions showed an overall alpha scale greater than 70% acceptable criteria (Table 2), suggesting that all variables met internal reliability consistency at aggregation levels. The validity of instruments used in each dimension met the convergent criteria as all correlations were greater than 0.30 and statistically significant at 1% level.

Table 3 shows the estimates of the ordered outcomes model and their respective p-values. Model fit indices are also reported. As expected, the cutoff points were all significant at the 5% level satisfying the relationship that 0<Cut point 1<Cut point 2<Cut point 3, and justifying no misspecification errors in the GLM regression (Maddala, 1983). From the statistical side, all parameter estimates were all significant, except that that the estimates of finding new digital opportunities was not significant at any level. This suggests that decision making policy should perhaps; (i) upskill and reskill its staff to accommodate with the new technology if any exists; and (ii) simplify digital processes that can save time and increase efficiency. In terms of sign, strategy resilient development and university autonomy had a negative sign while international collaboration and increasing funding's rate had positive sign, providing support for scientific collaboration management.

More importantly, Table 4 shows the marginal probability effect estimates and their respective standard errors for the generalized ordered Probit. Observe that the sum of all marginal effects estimates are equal to zero, implying the consistency of the estimates. On average, respondents are 22% points less likely to rate strategy resilient development variable as "excellent", while only 4% points are likely to rate strategy resilient development variable as "very poor." But 12% points likely to rate strategy resilient variable as being "excellent", while only 2.2% points are less likely to rate strategy resilient development variable as being "very poor."

Table 1. Statistics Descriptive for all Variables

DIMENSIONS	MEAN	MIN	MAX	SD	SE
Dimension 1: *Strategy Resilient Development* (5 items)		5	20	2.168	0.019
1. Clear set of principles that guide collaborative activities	10.988	1	4	0.699	0.026
2. Readiness to address risk and uncertainty	2.269	1	4	0.818	0.308
3. Well-chosen set of benchmarking with peers	2.179	1	4	0.753	0.028
4. Consultancy and advisory	2.098	1	4	0.819	0.308
5. Great talents for achieving greater results (strategy champion)	2.569	1	4	0.857	0.032
	1.873				
Dimension 2: *International Collaboration with Peers* (4 items)	10.803	4	16	2.070	0.077
6. Faculty inbound and faculty outbound	2.854	1	4	0.821	0.030
7. Joint education program	2.928	1	4	0.901	0.033
8. Joint research relevance to the Vision 2030 goals	2.699	1	4	0.943	0.035

9. Potential impact of joint research	2.322	1	4	0.722	0.029
Dimension 3: *Collaboration with Non-academic Sector* (4 items)	9.885	4	16	2.809	0.105
10. Collaboration and engagement with national private organizations	2.427	1	4	0.904	0.034
11. Collaboration and engagement with multinational organizations	2.322	1	4	0.919	0.035
12. Collaboration and engagement with public offices (e.g. ministry)	2.655	1	4	0.780	0.029
13. Collaboration and partnership with international cooperation agencies	2.481	1	4	0.871	0.032
Dimension 4: *Increasing Funding Rate* (4 items)	10.560	4	16	5.905	0.222
14. Knowledge and skills of the funding decision making team	2.678	1	4	0.978	0.036
15. Efficiency in securing news funding's resources	2.644	1	4	0.912	0.034
16. Effectiveness of grants and funds management	2.580	1	4	0.915	0.034
17. Partners funding commitment over time	2.658	1	4	0.912	0.035
Dimension 5: *Digital Opportunities for Competitive Advantage* (4 items)	11.769	4	16	2.332	0.105
18. Efficient resources collaboration	3.779	1	4	0.801	0.023
19. New technology development with impactful collaboration	3.278	1	4	0.789	0.024
20. Upskill and reskill staff to accommodate with the new technology	2.210	1	4	0.710	0.021
21. Simplified digital processes that can save time and increase efficiency	2.502	1	4	0.798	0.027
Single Measure					
22. Management of scientific Collaboration	3.232	1	4	0.571	0.012
23. University Autonomy	0.102	0	1	0.002	0.008

$$\frac{\left(\frac{Z}{d}\right)^2 (0.5)^2}{1+\frac{1}{N}\left[\left(\frac{Z}{d}\right)^2 (0.5)^2-1\right]}, \text{ where } d = 0.05, Z = 1.96, \text{ and } N = 660$$

Table 2. Internal consistency, convergent validity, and correlation between dimensions

Dimension	Internal Consistency Criteria	Convergent Validity Criteria	Correlations			
			1	2	3	4
1. STRATEGY RESILIENT DEVELOPMENT	0.861	0.38 – 0.84				
2. INTERNATIONAL COLLABORATION	0.770	0.40 – 0.53	-0.292*			
3. NON-ACADEMIC COLLABORATION	0.911	0.42 – 0.70	-0.619*	-0.226*		
4. INCREASING FUNDING RATE	0.876	0.75 – 0.85	-0.554*	-0.292*	0.569*	
5. DIGITAL OPPORTUNITIES	0.932	0.78 – 0.92	-0.756*	0.344*	0.301*	0.786*

Notes: Alpha > 0.70 and correlations > 0.30 stand for Cronbach 's Alpha and Pearson coefficients respectively

Responses are in Likert scale, with 1= very poor, 2 = poor, 3 = good, and 4 = excellent

* All correlations are significant at p<0.01

Number of observations, n = 205

As for the benchmarking analysis displayed in Table 5, the fields analyzed fall under four categories of scientific collaboration. While Saudi Arabia universities converge to all top ranked universities in international outcomes area (78.41%), they differ significantly in research environment (16.97%), research quality 68.7%), industry (32.38%). There is a real scope for significant advancement in ranking, especially establishing new partnerships in a very specific area with the top 100. For example, the United States of

America are represented with 36 universities out of the top 100 and may be considered for future scientific collaboration.

Table 3. GLM estimates for managing scientific collaboration for a meaningful added – value

	Estimates	*p-value*
STRATEGY RESILIENT DEVELOPMENT	-0.176**	0.011
INTERNATIONAL COLLABORATION	0.040**	0.025
NON-ACADEMIC COLLABORATION	-0.062**	0.028
INCREASING FUNDING RATE	0.085**	0.045
DIGITAL OPPORTUNITIES	0.085	0.321
UNIVERSITY AUTONOMY	-0.142***	0.000
*C*1/*Constant*	2.072***	0.000
*C*2	3.179***	0.000
*C*3	5.172***	0.000
MODEL FIT INDICES		
Model χ2 (Likelihood Ratio)	357.6*	
df	6	
-2LogL	1352.1	
BIC	1404.6	
AIC	1368.1	
N = 205		

Notes: A prior test of proportional odds of the dependent variable showed

$\chi2 = 27.377$, p=0.002, and DF = 11, violating the proportional odds assumption.

Hence, generalized ordered logistic model (GLM) was performed for this regression

Table 4. Average marginal probability effect estimates and their respective standard errors for the Generalized ordered Probit*

Independent variables	Rating Level			
	1 "Very poor"	2 "Poor"	3 "Good"	4 "Excellent"
STRATEGY RESILIENT DEVELOPMENT	0.045 (0.002)	0.077 (0.007)	0.098 (0.013)	-0.220 (0.022)
INTERNATIONAL *C*OLLABORATION	-0.005 (0.001)	-0.013 (0.003)	-0.022 (0.006)	0.040 (0.010)
NON-ACADEMIC COLLABORATION	0.005 (0.002)	0.019 (0.009)	0.034 (0.016)	-0.058 (0.027)
INCREASING & SECURING FUNDING	-0.026 (0.002)	-0.041 (0.007)	-0.053 (0.014)	0.120 (0.073)
DIGITAL OPPORTUNITIES	-0.013 (0.104)	-0.035 (0.224)	-0.051 (0.012)	0.099 (0.102)

Notes: *See Holey (2011), James, et al., (1982). Standard errors are between parenthesis.

Table 5. Benchmarking Saudi universities with top ranking universities**

	Research Environment	Research Quality	Industry	International Outlook
Top 50	85.44	93.63	91.25	83.66
Top 100	73.55	90.56	90.51	80.52
Top 200	61.16	87.71	87.36	77.51
Saudi Arabia[*]	**16.97**	**68.70**	**32.38**	**78.41**

Note: * As of November 2023, 22 universities are listed in THEs league table. The top 100 includes

36 universities from the United States of America.

** See Zuiderwijik, et al., (2005). for comparing open data benchmarks.

Conclusions and future research

The present research investigated possible factors that create major barriers in the field of scientific collaboration management at higher education level. The investigation used two different methods: (i) a new validated questionnaire that includes the opinions of a variety of research collaborators and alike positions at different Saudi universities; and (ii) a benchmarking analysis with top ranking list that was published by THEs.

Questionnaire results shows the emergence of two interesting contradictory factors. A positive and significant effect of funding opportunities, but a lack of a significant strategy development that is planned around resilience. In addition, the university autonomy is considered as a major burden in maximizing international collaboration impact since the government controls top leader appointments and all financial activities. This however has maintained the government's budget deficit for many years and affected the budget of many universities.

The author acknowledges the limitation of questionnaire studies in terms of sampling and scientific collaborators responses. It is reasonable to recognize that some high productive scientific collaborators did not participate or unintentially overlooked. But mixed studies that involve qualitative analysis along with opinions from external experts may contribute to enhance the results efficiencies. The greater contribution of this study is that new studies in this area built on the present findings, may explore a balance between the strategy development and its financial implementation from different perspectives to get meaningful results that add real values and secure long – term sustainability. In addition, as researchers seek to investigate more in this area, it is suggested that they consider the following: (a) a strategy should be developed with a wide range of resilience type could result in identifying different outcomes. Hence, researchers need to deepen their model specification on the resilience type to be included in the model, and conduct empirical studies to test such specification. (b) Universities seeking international scientific collaboration that create added value, may be reluctant to provide internal information such as their main key performance indicators (KPIs). This however, may create information asymmetries which make it difficult for partners to collaborate and managers to develop the right strategy.

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