



BMJ Open Conceptualising centres of excellence: a scoping review of global evidence

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ABSTRACT

Objective Globally, interest in excellence has grown exponentially, with public and private institutions shifting their attention from meeting targets to achieving excellence. Centres of Excellence (CoEs) are standing at the forefront of healthcare, research and innovations responding to the world's most complex problems. However, their potential is hindered by conceptual ambiguity. We conducted a global synthesis of the evidence to conceptualise CoEs.

Design Scoping review, following Arksey and O'Malley's framework and methodological enhancement by Levac *et al* and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews.

Data sources PubMed, Scopus, CINAHL, Google Scholar and the Google engine until 1 January 2021.

Eligibility Articles that describe CoE as the main theme.

Results The search resulted in 52 161 potential publications, with 78 articles met the eligibility criteria. The 78 articles were from 33 countries, of which 35 were from the USA, 3 each from Nigeria, South Africa, Spain and India, and 2 each from Ethiopia, Canada, Russia, Colombia, Sweden, Greece and Peru. The rest 17 were from various countries. The articles involved six thematic areas—healthcare, education, research, industry, information technology and general concepts on CoE. The analysis documented success stories of using the brand 'CoE'—an influential brand to stimulate best practices. We identified 12 essential foundations of CoE—specialised expertise; infrastructure; innovation; high-impact research; quality service; accreditation or standards; leadership; organisational structure; strategy; collaboration and partnership; sustainable funding or financial mechanisms; and entrepreneurship.

Conclusions CoEs have significant scientific, political, economic and social impacts. However, there are inconsistent use and self-designation of the brand without approval by an independent, external process of evaluation and with high ambiguity between 'CoEs' and the ordinary 'institutions' or 'centres'. A comprehensive framework is needed to guide and inspire an institution as a CoE and to help government and funding institutions shape and oversee CoEs.

INTRODUCTION

Globally, interest in excellence has grown exponentially, with public and private

Strengths and limitations of this study

- To the best of our knowledge, this is the first scoping review to conceptualise centres of excellence based on global evidence.
- The study followed Arksey and O'Malley's framework and methodological enhancement by Levac *et al* to analyse the evidence and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews methodological frameworks to guide the retrieval and inclusion of the evidence.
- Five databases were systematically searched to identify scientific and grey literature.
- The study was limited by language restrictions.

institutions shifting their attention from meeting targets to achieving excellence.^{1 2} The term centre of excellence (CoE) has been understood as a team, shared facility or entity that provides high standards of research, leadership, services or education, and brings innovative mechanisms to promote knowledge and scientific advancements.¹⁻³ The concept has been around since copyrighted by Humana Health Plan⁴; drawing the attention of scientists to enhance collaborations and cultivate access to resources essential for advanced research.⁵ It has been shaping institutions with ways to consolidate and build on their expertise and develop the capacity for scientific and financial gains.⁶ Organisations that work under the CoE model have been pooling existing highly skilled expertise and resources to work hard on their focus area and bring in superior performance and productivity over the others.⁷ The organisations leverage CoE as a specific mechanism to establish and drive world-class excellence within their technical or functional space.

Nonetheless, there has been no consensus as to what CoE means and what operational modalities it should follow and be ruled by.^{6 8} Although many centres are determined as CoE, there is no sufficient clarity as to what

constitutes a CoE, the resource requirements, the nature of change they would make, and the processes and activities necessary to sustain the CoE. In the area of healthcare, CoE has been looked at as a specialised programme with potential expertise and resources focusing on particular medical areas and providing exceptional outcomes.^{9 10} Some experts in the field pinpoint particular fronts that distinguish CoE from traditional healthcare delivery models—organisation design, servicescape design, personnel, medical care, marketing and finance.^{9 11} Moreover, many research and higher education institutions^{12–16} and healthcare institutions^{17–20} across different countries have pursued a CoE status with claims that such institutions have bold distinctions in capacity, resources and outcomes even among themselves. For instance, the African Research Universities Alliance (ARUA) establishes CoEs within its member universities where world-class researchers from member universities assemble to carry out joint researches in 13 priority thematic areas. Drawing on existing university infrastructure and human resources, each CoE needs to bring together leading researchers from Africa and elsewhere in working groups and conduct cutting-edge research that is innovative and with the potential for transformation. ARUA explains CoE as an assembly point for good and committed researchers and students seeking to do cutting-edge work. It conceptualises CoE as a team, a shared facility, or an entity that provides leadership, best practices, research, support and/or training for a focus area which might be a technology, a business concept, a skill or a broad area of study.

Despite these assertions, there is ambiguity and inconsistency in the use of the term, the process of designations, processes of evaluation, and metrics. In this study, we conducted a global synthesis of the evidence to conceptualise CoEs.

METHODS

We followed a scoping review procedure to provide greater conceptual clarity and map CoE from heterogeneous sources. Scoping review is the most preferred approach to systematically identify and map key concepts, theories and sources of emerging evidence and gaps in the research. We used Arksey and O'Malley's framework for scoping reviews,²¹ which has been further enhanced by Levac *et al.*²² to analyse the evidence. We also used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension (PRISMA) for Scoping Reviews²³ to guide the retrieval and inclusion of the evidence. The review was conducted following the stages described below:

Stage 1: identifying the research question

This stage involved in-depth discussion and consultation with the study team and study collaborators. The main research questions were the following:

- ▶ How are CoEs defined?
- ▶ What are the building blocks of a CoE?

- ▶ What are the frameworks and functions of CoEs?
- ▶ What does it need to establish and sustain a CoE?

Stage 2: identifying relevant studies

Search strategy and sources

Relevant empirical and peer-reviewed literature were sourced from electronic databases and search engines including PubMed, Scopus, CINAHL and Google Scholar up to 1 January 2021. Handsearching of contents was conducted for key journals including the Journal of Excellence, International Journal of Excellence in Education, Journal on Centers for Teaching and Learning, International Journal of Business Excellence, Journal of Excellence in College Teaching, Equity and Excellence in Education, Excellence in Medical Education, Journal of Universal Excellence, Excellence International Journal of Education and Research, and Measuring Business Excellence. A precise search strategy for one database is included in online supplemental table 1.

To ensure that all relevant information were captured, we searched the Google engine for grey literature including conference proceedings, working papers, newsletters, business documents, presentations and reports, government documents, technical documents, white papers, policies and bulletins. The references of included literature and documents were also handsearched to get any additional evidence.

The databases were searched using both natural language and controlled vocabulary for 'excellence' and the following terms within publication title and/or abstract: Centers of Excellence; Centers of Excellence for Education; Centers of Excellence for Research; Sustaining Centres of Excellence; Barriers to Achieving Excellence; Leadership for Excellence; Promoters of Excellence; Infrastructure for Excellence; and Collaborations for Excellence. The search term "Excellence" was further extended to include all relevant words through a search of definitions from dictionaries.

Eligibility

To be included in the review, sources of evidence needed to describe CoE as the main theme, which could be defining, theorising, implementing or evaluating a CoE. The search had no restrictions applied on the year of publication, publication status or geographical location to ensure comprehensiveness of coverage, while non-English language literature were excluded. Duplicate citations were also excluded from the initial database.

Stage 3: study selection

An extensive title screening, summary screening, and full-text screening strategy were developed to identify all relevant literature and documents. The title and abstract of all records retrieved were downloaded to and independently assessed for eligibility and screened by two authors after removal of duplicates. Disagreements between the reviewers were decided by consensus. Full-text copies of

potentially relevant papers were retrieved for in-depth review.

Stage 4: data charting

Data extraction used a standardised form developed by the investigator team. Information was extracted from each included document on (1) description of the document, including the primary author, publication year and search engine; (2) Thematic area; (3) Essential foundations of the CoE and (4) description of the major finding of the article. We checked if the CoEs had their status approved by an independent body or if they have a standard recognition to function as a CoE. We also checked if the CoEs have described the major barriers and opportunities in the establishment and sustaining of their CoE. Before extracting the actual data, the data extraction sheet was pilot-tested on 10 randomly selected studies, and the extraction sheet was refined as needed. Two authors (TM and AF) extracted the data.

Stage 5: collating, summarising and reporting the results

The results of the review were synthesised and narratively reported. The steps included thematic content analysis for qualitative information; numerical counts and tables for quantitative data; narrative summary and interpretation of all the results; and discussion of gaps in the literature.

Assessing the risk of bias across studies was not feasible due to expected high levels of variation in scope, setting, and time between studies. All given results were included to minimise the risk of selective reporting.

Patient and public involvement

No patient was involved.

RESULTS

Study selection in the PRISMA review

Overall, 52 161 potential documents were included in the initial review from PubMed (n=15 778), Scopus (n=7168), CINAHL (n=1150), Google Scholar (n=10 213), Google engine (n=8142) and other sources (n=23), of which 23 432 were retained after removing duplicates. Following an initial screening, 346 full-text articles were evaluated, of which 78 met the inclusion criteria and were included in the review (figure 1).

Characteristics of the included studies

The 78 full-text articles included were affiliated with institutions globally from 33 countries, of which 35 were from the USA, 3 each from Nigeria, South Africa, Spain, and India, and 2 each from Ethiopia, Canada, Russia, Colombia, Sweden, Greece and Peru. The rest 17 were from various countries.

The articles involved six thematic areas—health services, education, research, industry, information technology and a general concept of CoE. See online supplemental table 2 for detailed information on individual study characteristics, including the name of the primary author and publication date, country of study

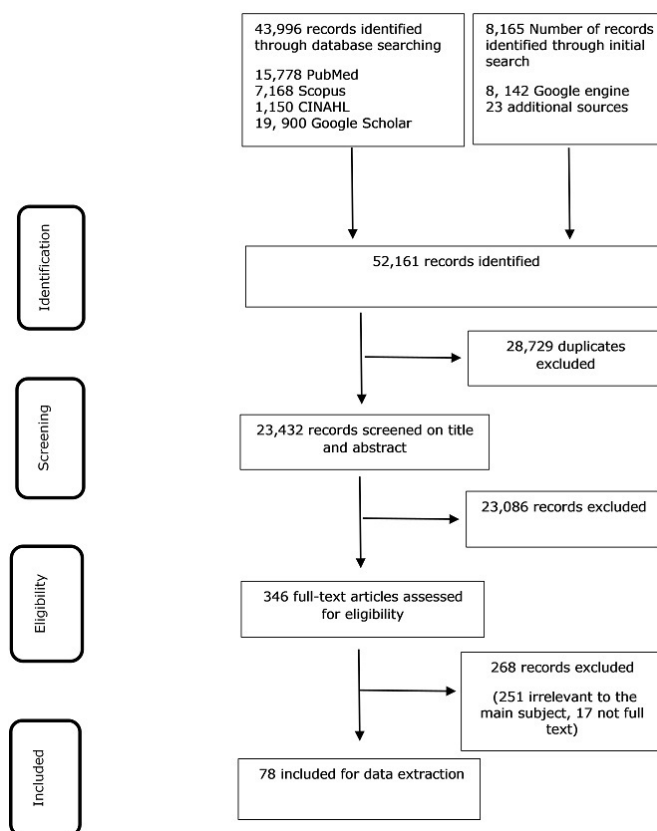


Figure 1 Flow diagram of the study.

origin, name of the designated CoE if any, thematic area of the literature, the essential foundation of the CoE and a brief description of the key message in the literature.

Definition of CoE

CoE is a team of specialised expertise^{2 7 17 24–47} or organisational environment^{2 5 24 30 35 36 48–56} that is established to provide outstanding healthcare,^{2 7 12 17 24–39 41 48 50 51 57–74} research,^{12 17 24 26–28 31 36 40 41 50 52 58 68 72 74–85} education and training,^{12 17 24 25 31 36 38 42 43 68 73 74 76 81–83 85–88} regulatory,^{57 83 89} policy,^{46 49 54 55 82 90} information technology^{45 53 91} or industrial^{44 92 93} services and support in high levels of efficient and effective performance. CoEs are geographically concentrated and focused on high potential in science and industry,⁴⁶ as a world leader or a catalyst between neighbouring countries,^{60 72 82} anywhere from the local research and development (R&D) group up to a network of cooperative partners. They are characterised by the scope of their operations, mandates, funding, executive sponsorship, commitment, responsibilities and powers.⁹⁴ Historically, CoE is leveraged by IT leaders seeking to facilitate the creation of hubs for knowledge sharing and building and enhancing capabilities. The idea had evolved and been used in favour of different targets in the last decade.⁵⁵ Its driver, ‘Excellence’, was not considered an act that has to do with the end product, but a habit to do with the process.

Functions of CoE

When a CoEs is established, it is most often because of a need for implementation infrastructure, the existence of specific relationships, and availability of funding.⁴⁹ Its establishment could favour critical research infrastructure, foster collaboration, train experts and share core facilities.⁶⁸ Regardless of strategic orientation, all CoEs have in common the notion of excellence and the particular requirements that come with that label, such as high research quality and productivity, resource attraction and concentration, international visibility and attractiveness, and organisational robustness.⁴⁶

Within the vertically different higher education, excellence is being equated to 'being better' which could mean, excellence in research, top-quality professors, favourable working conditions, job security and good salary and benefits, adequate facilities, adequate funding, academic freedom, an atmosphere of intellectual excitement and faculty self-governance.⁹⁵ Higher education institutions develop such CoEs to address the ongoing critical need for more intensive and specialised training on a specific condition.^{12 81 95}

In the healthcare sector, CoEs can provide breakthrough treatments on specific disease conditions.^{26–33} In line with the current COVID-19 pandemic, some hospitals and universities have established COVID-19-specific CoEs.^{24 96}

CoE could be established to provide specific regulatory decision making, including to advance the development and regulation of products^{25 83} and to fill in knowledge gaps.⁹⁷ For instance, the World Bank has an Eastern and Southern Africa Higher Education Centers of Excellence project that strengthen selected Eastern and Southern African higher education institutions to deliver quality postgraduate education and build collaborative research capacity in the regional priority areas.⁸²

Essential foundations of CoE

There were 12 essential foundations on which CoE could be based according to the review of the 78 literature (figure 2). Gaining and retaining such foundations could cultivate the good nature of a CoE, creating more realistic possibilities and opportunities to function as a CoE.

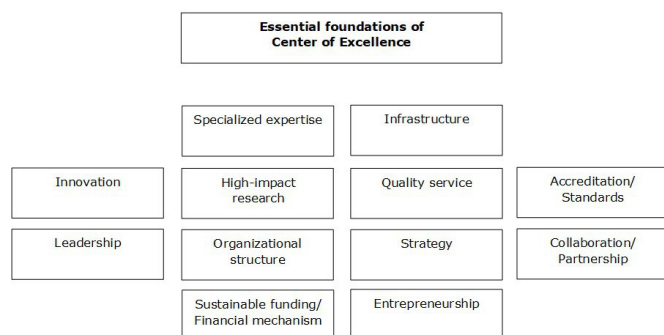


Figure 2 Essential foundations of CoE in literature. CoE, centres of excellence.

Table 1 Frameworks and models of centres of excellence (CoE)

Framework or model	Literature that cited the framework/model
Willis-Knighton's Health System CoE delivery model	Elrod <i>et al</i> ²
REAL-PANLAR Group quality standard requirements for CoE model	Santos-Moreno <i>et al</i> ⁷
Activity-based typing of CoEs	Heyes ⁴⁷
Critical capacities of a CoE	Metrick <i>et al</i> ⁴⁹
Generalised Criteria and Evaluation Method for CoE	Craig <i>et al</i> ⁵³
Key steps to establishing a CoE	Patel <i>et al</i> ⁵⁴
IFSO requirement for CoE programme participation	Melissas <i>et al</i> ⁶⁰
Lean Six Sigma	Itri <i>et al</i> ⁶⁴ ; Ferguson <i>et al</i> ⁶⁶
E-CoRE conceptual framework	Househ <i>et al</i> ⁷²
Three-impact dimensions	Borlaug ⁷⁹
Research Excellence Framework	Terama <i>et al</i> ⁸⁴
Curriculum development framework	Cofrancesco ⁸⁵
Four-domain curricular model	Rugen <i>et al</i> ⁸⁶
Excellence in higher education evaluation model	Brusoni <i>et al</i> ⁹⁴

Frameworks and models of CoE

Fourteen of the 78 included articles have used or developed a specific framework or model to establish and shape their institutions as a CoE or to distinguish CoE from the traditional institutional or service delivery model. Table 1 summarises the frameworks employed.

Elrod and Fortenberry² looked at CoE under the umbrella of the Willis-Knighton Health System and identified six particular fronts—organisation design, service design, personnel, medical care, marketing and finance—that distinguish CoE from traditional healthcare delivery models. Addressing each of these fronts yield an exceptionally high level of care largely exceeding that delivered in traditional settings. Elrod and Fortenberry considered CoE in healthcare as a programme that is assembled to supply an exceptionally high concentration of expertise and related resources centred on a particular area of medicine, delivering associated care in a comprehensive, interdisciplinary fashion to afford the best patient outcomes possible.

Santos-Moreno *et al*⁷ employed the REAL-PANLAR Group model as a requirement for implementation and accreditation of CoEs in rheumatoid arthritis care. The framework defined three types of CoEs based on structure, process, and outcome indicators—standard, optimal and model. To maintain the comprehensive nature of care, all criteria must be met with a minimum score of 80% for each of the criteria. The approved standards for the 'standard' CoE should have a basic structure and process indicators, the 'optimal' level should accomplish more structure and process indicators, and the 'model' level should fulfil outcome and patient experience indicators.

In addition and regardless of institutional category, all CoEs should meet the same standards, and according to the philosophy of the accreditation system, the concepts of continuous improvement and patient-centred management must be included.

Heyes,⁴⁷ as part of his assessment of the nuclear security CoEs, grouped CoEs into five types based on their core activities. Group A centres where the core activities are essentially technical and scientific with a focus on providing training on the use, calibration, and maintenance of equipment. Group B centres where the core activities are essentially educational, offering the course(s) which, although they may have technical content, are designed to provide a broad perspective of nuclear security and an awareness of relevant issues. Group C centres where the core activities encompass a wider range of topics than just nuclear security, or even wider than nuclear security, safety, and safeguards. Group D centres where the core activity is focused on nuclear R&D or which are characterised by strong commercially driven objectives. Group E centres where the core activities are focused on raising awareness of nuclear security issues within the nuclear industry and beyond.

Metrick *et al*⁴⁹ indicated that every CoE's scope of work should have four critical capacities - implementation support, continuous quality improvement for identified interventions, workforce development and technical assistance. As the initial scope of work is refined, these criteria should be used to begin to identify possible organisational candidates to house the CoE.

Craig *et al*⁵³ proposed a framework that characterised the successes of a CoE through five dimensions—internal business process, customer focus, leadership, innovation and learning, and finance. The framework integrated elements of the balanced scorecard and the Baldrige Criteria for Performance Excellence to form a background for evaluating organisations as CoE.

Patel and Andrews⁵⁴ proposed a seven key-steps framework to consider in creating a CoE. The steps included defining the CoE and setting vision statement and guiding principles, determining the overall scope for the COE which has three types including knowledge-sharing focus, strategy/guidance focus and strategy/guidance focus with implementation/support focus.

Melissas *et al*⁶⁰ applied the IFSO (International Federation for the Surgery of Obesity and Metabolic Disorders) requirement for CoE programme participation. The IFSO provides designation as CoE in bariatric and metabolic surgery for institutions fulfilling ten requirements focusing on experts' capacity, infrastructure, a facility set up and appropriate technologies. The authors improved healthcare services following participation in the IFSO.

Itri *et al*⁶⁴ and Ferguson *et al*⁶⁶ used the Lean Six Sigma framework with its five distinct phases—define, measure, analyse, improve and control—to establish CoE in healthcare settings. The authors proved that the framework is effective in establishing and organising CoEs.

Househ *et al*⁷² were guided by a conceptual framework that is comprised of the production, dissemination, and use of knowledge in their establishment of an Electronic Health Centre of Research Excellence. In the framework, knowledge was produced as a result of research efforts, innovation and collaboration, and such generated information is used to formulate decisions.

Borlaug⁷⁹ developed a conceptual framework involving three impact dimensions—organisational, social and international—to examine how CoE schemes have been adapted to two distinct national public research systems in Norway and Sweden. With this framework, the author identified that funding agencies emphasised organisational impact in a country with a highly competitive funding system.

Terama *et al*⁸⁴ applied Research Excellence Framework to assess the quality and reach of research in UK universities and allocate funding accordingly. The framework assesses the quality of research in higher education institutions in terms of three elements—originality, significance and rigour of research outputs; reach and significance of impact; and vitality and sustainability of research environment. The framework was instrumental in establishing education excellence, while it was unlikely to fully reflect all of the impacts of university research.

Cofrancesco *et al*⁸⁵ used the six-step curriculum development framework to inspire and support the development and outcomes of excellence in education programmes. The steps included problem identification and general needs assessment; targeted needs assessment; setting goals and objectives; educational strategies; programme implementation; and evaluation and feedback. The authors developed and implemented the Institute for Excellence in education as a structure that works to promote, improve and innovate medical and biomedical education and scholarship.

Rugen *et al*⁸⁶ developed a curricular model with four domains—shared decision making, sustained relationships, interprofessional collaboration and performance improvement. Cofrancesco aimed at achieving CoE in primary care education. The model transformed healthcare training from a profession-specific primary care delivery approach to an inter-professional, team-based, patient-centred care delivery paradigm.

Brusoni *et al*⁹⁴ framed seven evaluation extents to define excellence in higher education—leadership, purposes and plans, beneficiaries and constituencies, programmes and services, faculty/staff and workplace, assessment and information use, and outcomes and achievements. Excellence in Higher Education provides a structured guide for reviewing each of these areas as they operate within a particular institution, department or programme.

DISCUSSION

Our analysis of the scientific and grey literature documented success stories of using the brand 'CoE' within the healthcare, research, education, information technology

and industry. There were some key milestones commonly applicable to many CoEs; however, there was inconsistent use and self-designation of the brand 'CoE' without approval by an independent, external process of evaluation, and with high ambiguity between 'CoE' and the ordinary 'institution' or 'centre'. In the developing world, the concept of CoE is getting significant attention, particularly in research and higher education sectors where senior professors are fairly concentrated as our analysis pinpoints. Our review led us to define CoE as a team of specialised expertise or organisational environment that is established to provide outstanding healthcare, research, education and training, regulatory, information technology or industrial services, and support in high levels of efficient and effective performance.

Our analysis showed that a comprehensive framework is needed to guide and inspire an institution as a CoE. There were some existing frameworks that the CoEs used as a benchmark to shape the establishment and implementation of their CoEs; however, there were some important limitations with the frameworks:

1. The frameworks were limited to demarcating the unique features of a CoE as compared with an ordinary institution.
2. The frameworks were limited to specific facilities or services without analysis at a larger scale.
3. The frameworks lacked parameters and levels of indicators to use to follow-up or improve the performance of the CoEs, unlike many accreditation requirements for different research and education ventures.
4. The frameworks were not sufficient to enhance CoEs to acquire excellence in both research and education when these two ventures are allied. There were many CoEs tagged as 'CoE for Research and Education'. As one compliments the other, it could be possible to achieve excellence in both as a singular goal.
5. Giving particular emphasis to CoEs in developing countries, the frameworks did not recognise the issue of resource potential and stewardships in such settings.

The scoping review indicates that highly specialised expertise is one of the layers on top, with the number and multidisciplinary nature of the experts influencing the competency of a CoE with the rapidly changing knowledge and development landscape. The CoE needs to ensure that it has the right technical, administrative and operational functions in place, bringing in the right subject-matter expertise at the right time to deliver targeted outcomes. The appointment of expertise needs to be merit based, taking into account each member's education, training, experience and the broader vision of long-term requirements.

State-of-the-art infrastructure is preeminent in defining and transforming an institution as a CoE. Such infrastructure raises productivity and inspires specialised expertise from different contexts and countries to visit, practice and collaborate. Structurally, the CoEs could be a stand-alone promise or a confirmed part of a legal institution as a separate division in an institution, or a hub location

for multicountry functions. The CoE needs to promote a global view aimed at enhancing healthy competitions on a global platform and promoting the development of globalised knowledge. It should benchmark its infrastructure and performance against equivalent CoEs in other settings or countries.

The CoE needs to cultivate innovations to create and transform new ideas, knowledge and procedures that incrementally improve its success and stay ahead in the face of extreme competition. The CoE needs to introduce cutting-edge technologies, devices, or applications that maximise its productivity and competitiveness. For a CoE that focuses on R&D, its research outputs should have a high impact on the knowledge economy for substantial changes beyond scholarly roles. The CoE needs to work to convert its academic or research outputs into new business ventures through an entrepreneurship platform. For a CoE that focuses on service delivery, it should provide services that consistently delight customers' individual needs and preferences. This includes developing standards of service quality and continuously measuring improvements to raise service quality and create more efficient methods of service delivery. The CoE needs to value accreditation schemes by an external evaluator to continuously measure and assure service quality and enhance its status and reputation.

Leadership is one of the critical components of a CoE. The CoE requires a powerful, goal-oriented leadership to passionately lead the team in a given direction and drives toward success. The CoE leader should have the maximum commitment to achieving excellence, with the potential to influence the overall functions and long-term visions of the CoE. The leadership should explore sustainable financing mechanisms which could be sourced from government institutions, funding agencies, public-private partnerships or generation of revenues through consultancy, training or research services. The leadership should make sure that its staff is highly motivated and ambitious. The CoE needs to develop and implement an organisational structure that works best for its particular interest. This should be supported by a roadmap and strategy that defines the broader vision, mission, goals and objective that deal with the long-term desired status of the CoE.

CONCLUSION

CoEs have significant scientific, political, economic and social impacts. However, there are inconsistent use and self-designation of the brand without approval by an independent, external process of evaluation, and with high ambiguity between 'CoEs' and the ordinary 'institutions' or 'centres'. A comprehensive framework is needed to guide and inspire an institution as a CoE and to help government and funding institutions shape and oversee CoEs.

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