Software Engineering Institute

Generalized Criteria and Evaluation Method for Center of Excellence: A Preliminary Report

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December 2009

TECHNICAL NOTE
CMU/SEI-2009-TN-011

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This report was prepared for the

SEI Administrative Agent
ESC/XPK
5 Eglin Street
Hanscom AFB, MA 01731-2100

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This work is sponsored by the U.S. Department of Defense. The Software Engineering Institute is a federally funded research and development center sponsored by the U.S. Department of Defense.

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Foreword

This paper was prepared for the Software Engineering Directorate, Research, Development, and Engineering Center, Army Aviation and Missile Command.

In accordance to the Carnegie Mellon® Software Engineering Institute (SEI) work plan, this document is to be considered a preliminary description of a proposed approach for center of excellence certification and is submitted to the Software Engineering Directorate, Research, Development, and Engineering Center, Army Aviation and Missile Command only for its use in further developing center of excellence certification criteria.

The document presents a proposed approach and does not represent a total SEI endorsement of the approach.

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Abstract

Centers of Excellence (COEs) are created throughout the federal government in all domains to signify expertise important for elevating the significance of the product or service that is provided. But how are these COEs designated, accredited, or certified? Are there means of auditing, assessing, or appraising them? How do they achieve their "Center of Excellence" appellation? The answer is not clear-cut or without mystery. It is often a matter of trust to accept that the excellence declared in any COE domain exists.

Criteria and standards to certify an organization as a COE are presented in this Carnegie Mellon Software Engineering Institute preliminary report. These standards are derived, in part, from the balanced scorecard business approach and reflect criteria suggested by the U.S. Army Aviation and Missile Research, Development, and Engineering Center, Software Engineering Directorate (SED).

An assessment approach was developed employing established criteria and standards to certify an organization. The assessment approach took advantage of the established appraisal, assessment, and audit methodology. Other assessment approaches, such as ISO audit techniques, were investigated and incorporated as appropriate.

1 Introduction

This paper discusses the approach and results in developing a set of generalized criteria and an evaluation methodology to be used in certifying organizations under the jurisdiction of the Army Materiel Command (AMC) Chief Information Officer (CIO) as centers of excellence (COE) for their respective domains.

The AMC CIO/Chief Technology Officer (CTO) expressed a desire to establish centers of excellence for selected organizations under his jurisdiction.

In supporting this need, Aviation and Missile Research, Development, and Engineering Center (AMRDEC) Software Engineering Directorate (SED) proposed to establish a center of excellence for the domain MIMOSA.[1] As part of the establishment, AMRDEC SED recommended that each such organization be required to be "certified" (within their selected domains) in order to be classified as a COE.

The certification process would require generalized criteria and an evaluation methodology using these criteria. The concept of generalized criteria is that they could be applied to candidate COEs in different domains.

Certification would be granted by the AMC CIO/CTO using evaluation scoring data derived from third party (i.e., objective) evaluators.

Tasks involved in developing the certification process for centers of excellence included the following:

- researching relevant information on the definition, establishment and evaluation of centers of excellence
- generating a framework that sets the context for the criteria
- defining elements of this framework, its evaluation methodology, and evaluation scoring criteria, including
  - developing a definition of a center of excellence and other definitions to support a consistent approach to certifying an organization as a COE
  - developing criteria to be used in an evaluation, leading to certification of an organization as a COE in accomplishing its assigned mission
  - developing an evaluation approach or methodology employing the established criteria to certify an organization as a COE
  - developing a presentation reporting the results of the evaluation

1 The Machinery Information Management Open Systems Alliance (MIMOSA) is a not-for-profit trade association dedicated to developing and encouraging the adoption of open information standards for operations and maintenance in manufacturing, fleet, and facility environments. MIMOSA's open standards enable collaborative asset life-cycle management in both commercial and military applications.

2 Approach

2.1 Definitions

In developing the certification framework described here, definitions were required to set context. These definitions are the structural members of the center of excellence framework and help to integrate the various framework dimensions, associated criteria, and evaluation methodology. The definitions were developed to ensure the criteria and subsequent evaluation methodology could be applied consistently. For example, words such as quality and performance are often used, but are seldom defined or understood by all in the same way.

2.2 Center of Excellence Framework

The framework and the approach to developing the appropriate criteria were derived from elements of both the balanced scorecard (BSC) [Kaplan 1998] and the Baldrige Criteria for Performance Excellence [Baldrige 2008]. Both of these frameworks address measuring the health and performance of an organization. There are common dimensions in both of these frameworks. Specifically, the balanced scorecard methodology is based on four perspectives (or dimensions) of an organization's performance—customer focused, financial, internal business process, and learning and growth. These are depicted in Figure 1.

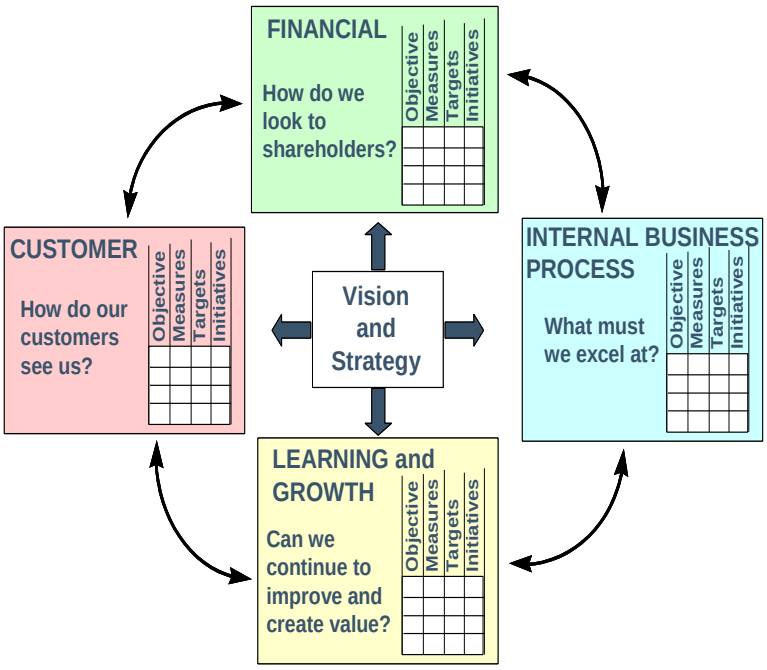

Figure 1: Balanced Scorecard Dimensions

The Baldrige Criteria for Performance Excellence framework embodies seven categories: leadership; strategic planning; customer and market focus; measurement, analysis, and knowledge; workforce focus; process management; and results.[2] We used the leadership category for the COE framework. In addition, scoring guidelines are provided against which an organization's performance can be judged and rated. The Baldrige scoring guidelines contain five levels of performance excellence for each dimension being evaluated.

The framework is shown in Figure 2.

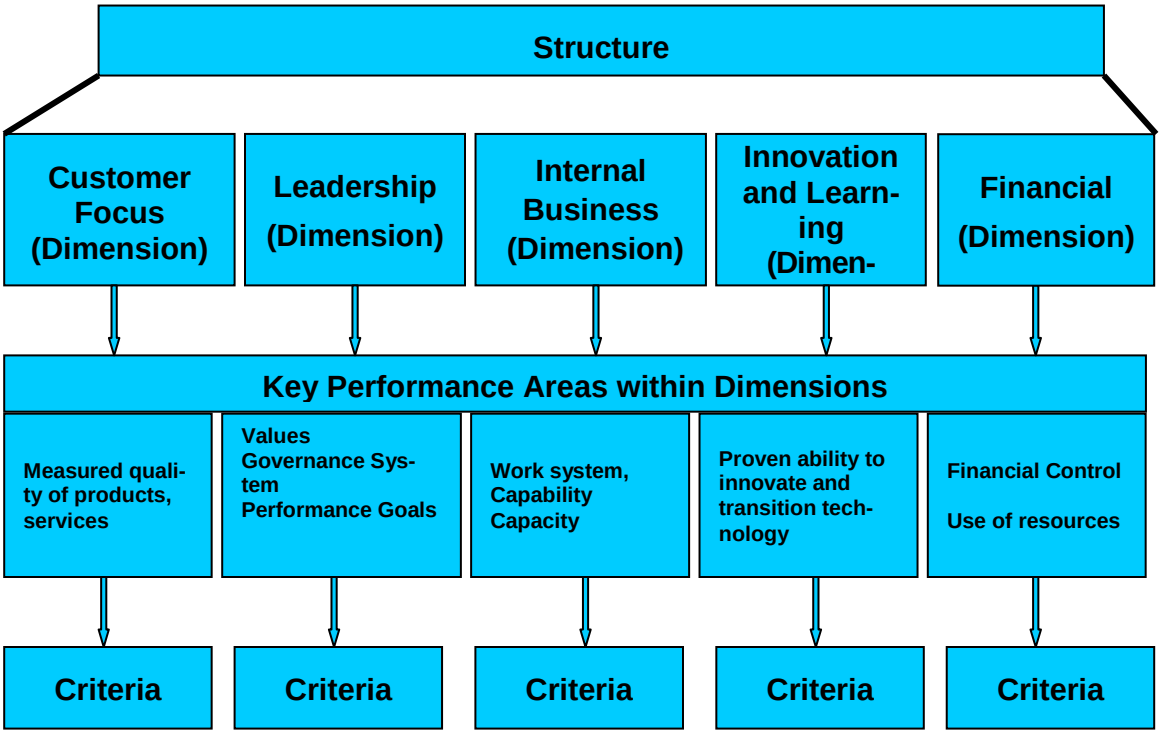

Figure 2: Certification Framework

2.2.1 Framework Key Performance Areas (Characteristics)

The key performance areas (or characteristics) for each dimension further define the basic definition of a center of excellence and provide descriptions of what the organization should possess or exhibit for that dimension. These characteristics help set the context for the criteria. For example, a COE must have the capacity and capability to accomplish its mission. To make the criteria more applicable to the organizations that might be certified, the characteristics were not focused on a specific domain—MIMOSA, for example. Rather, these characteristics are described in terms of assigned mission area, thereby being applicable to any domain. Also note that the characteristics

2 Note that these categories overlap in concepts to some extent with the concepts embodied by the BSC dimensions shown in Figure 1. A more detailed mapping of the exact overlap is beyond the scope of this document.

to be included are a mix of behaviors, values, assets, and other attributes relevant to that dimension. This implies that the evaluators for a COE need to be conversant in the wide variety of criteria.

2.2.2 Framework Criteria

The criteria for each framework dimension follow from the characteristics, and are the standard against which the COE candidate organization will be judged as achieving the level of excellence required by that organization in each dimension of the framework. First, the criteria are written to ensure they are measurable and observable (the criteria must include the phrase "documented evidence"). This inclusion allows the use of an evaluation methodology to have artifacts rather than obtaining evidence solely from interviews.

2.2.3 Framework Scoring Criteria

The proposed evaluation method follows the high-level flow of a process assessment with the scoring criteria noted below. It is meant to have an objective, qualified third party follow the high-level steps of planning, conducting, and reporting the evaluation results. Actual certification lies with the AMC CIO/CTO using evaluation results.

The scoring criteria are the way the evaluators rate the performance excellence of the organization. Following the Baldrige approach, the scoring criteria contain five levels for each dimension being evaluated. The characteristic of the lowest level is that none or few of the criteria for that dimension have been satisfied; at the highest level, most to all of the criteria for that dimension have been satisfied and that there is a measure of excellence above the basic criteria that is observably present.

3 Generalized COE Criteria and Evaluation Methodology

3.1 Center of Excellence Definition

Research provided several definitions of a center of excellence, a few of which were relevant to the goals of AMRDEC SED and AMC. However, most self-proclaimed COE organizations based their definition more on what the particular center does (functions) in its domain ("center of excellence for cancer research," for example) rather than using a more general definition of a COE as a starting point.

Synthesizing the available definitions, the authors developed a general definition, augmented by characteristics for each framework dimension being considered. That is, the dimensions contain key performance areas or characteristics of a COE that are expected to be found in the organization. The additional characteristics help further define the requirements for a COE, thereby leading to definitions of the criteria for each framework dimension being considered.

The general definition, derived from a Training and Doctrine Command (TRADOC) definition modified to focus on technology development, is as follows:[3]

> *A center of excellence is a premier organization providing an exceptional product or service in an assigned sphere of expertise and within a specific field of technology, business, or government, consistent with the unique requirements and capabilities of the COE organization.*

3.2 Center of Excellence Framework

Following from the definition above, a COE is an organization recognized as a world leader in accomplishing its mission. In this framework, that accomplishment is characterized via the following dimensions:

- internal business process
- customer focus
- leadership
- innovation and learning
- financial

The COE framework is shown in Figure 2.

3 TRADOC defines a center of excellence as a premier organization that creates the highest standards of achievement in an assigned sphere of expertise by generating synergy through effective and efficient combination and integration of functions while reinforcing the unique requirements and capabilities of the branches.

3.2.1 Key Performance Areas and Criteria for Dimensions

3.2.1.1 Internal Business Dimension

Key Performance Areas

A COE

- *has the operational work system,*[4] *capacity, and capability to accomplish its assigned mission in an outstanding manner where*
  - *its operational work system is aligned with organizational needs as determined by the organization and is repeatable, integrated, and applied consistently*
  - *it has the capacity (environment) to accomplish mission or tasks (e.g., equipment, facilities, work, and support processes exist and are in use)*
  - *it has the capability (leadership, both management and technical), knowledge and skills, and an education system for all employees exists and is in use*
- *consistently equals or exceeds established effectiveness and efficiency requirements in its measured operational performance in accomplishing the assigned mission*
- *collects and uses measures to make management decisions in managing the internal business*

Criteria

Documented evidence that indicates

- *the assigned mission has been authorized by official sources*
- *the current mission and function statements have been written in accordance with established standards, have been approved, and are accessible by stakeholders as well as program staff*
- *processes to accomplish the assigned mission are documented, institutionalized, and are being implemented (institutionalization is the ingrained way of doing business that an organization follows routinely as part of its corporate culture)*
- *the environment, including the facilities, is sufficient and is being used to accomplish the mission*
- *knowledge and skills necessary to carry out the mission are in place as part of personnel training and evaluation*
- *an operational plan is in place and being implemented*
- *a measurement and analysis program is in place for the COE candidate*
- *the operational performance has been measured, measures analyzed, and results of the analyses stored and made accessible to key leadership personnel, appropriate stakeholders, and program staff*
- *results of analyses have been and are being used to manage the program*
- *results of analyses have been and are being used to identify improvements in the approach*

---

4 "Operational work system" refers to the combined processes used to produce the desired products and services. The term "operational work systems" refers to how the work of the organization is accomplished.

3.2.1.2 Customer Focus Dimension

Key Performance Areas

A COE

- *provides measured, customer-focused performance*[5] *addressing customer satisfaction*
- *elicits customer needs or requirements proactively and collaboratively*
- *responds in a timely manner to customer requests*
- *delivers customer-defined, high-quality products and services*
- *anticipates customer issues and problems compatible with the COE mission*

  (Example measures and indicators include customer retention, complaints, customer survey results, product reliability, on-time delivery, customer-experienced defect levels, and service response time.)

Criteria

Documented evidence that indicates

- *customer relationships are established and maintained*
- *customer relationships result in customer satisfaction and retention*
- *processes and mechanisms for customer interaction (e.g., customer-facing web-based systems) have been established and implemented for*
  - *proactive elicitation and analyses of customer, as well as other stakeholders', needs and constraints*
  - *translation of customer needs and constraints into program requirements and service requirements that are agreed to by the customer (for example, schedules, cost, effort, and product requirements such as functionality and product quality attributes)*
  - *interacting with the customer for delivery of services (in doing this, an organization begins to understand the customer's situation in sufficient depth to anticipate future needs, thereby being ready with new ideas when the customer is looking for them)*
- *customer requirements for quality attributes (e.g., confidentiality and security) are elicited, analyzed and validated*
- *a measurement and analysis program is in place for customer interaction*
  - *customer-focused performance has been measured, measures analyzed, and results of the analyses stored and made accessible to the key leadership personnel, appropriate stakeholders, and program staff*
  - *results of analyses have been and are being used to manage the program*
  - *results of analyses have been and are being used to identify improvements in the approach*

5 Customer-focused performance refers to performance relative to measures and indicators of customers' perceptions, reactions, and behaviors related to the COE mission, and to measures and indicators of product and service characteristics important to customers and their customers. Examples include customer retention, complaints, customer survey results, product reliability, on-time delivery, customer-experienced defect levels, customer engagement level on "new" problems, and service response time.

Examples of measures include

- *evidence of customer retention with rationale*
- *number of complaints received per product*
- *customer survey results*
- *product reliability*
- *variance of on-time delivery for projects*
- *customer-experienced defect levels*
- *service response time*
- *effective service to customers*

These example measures must be operationalized by the organization to "fit" its domain and mission. For example, *effective* may be defined as adequate to achieve intended purpose or desired result. For the COE the term *effective* refers to how well a process or a measure addresses its intended purpose. Determining effectiveness requires (1) the evaluation of how well the process is aligned with the organization's needs and how well the process is deployed, or (2) the evaluation of the outcome of the measure used.

3.2.1.3 Leadership Dimension

Key Performance Areas

A COE

- *has proactive leadership to create and promote an environment for empowerment, innovation, organizational agility, and organizational and employee learning*
- *has senior leaders intrinsically involved with setting organization performance goals and expectations, setting and deploying organizational values, establishing short- and longer term direction focused on creating and balancing value for customers, their customers, and other stakeholders*
- *has senior leaders who communicate values, vision, directions, key decisions, and expectations through the leadership system to all employees*
- *has senior leaders regularly reviewing organizational performance for improvement purposes and needed actions*
- *has senior leaders focus on sustaining and growing the organization in terms of both the depth and breadth of its expertise*
- *has senior leaders who focus on finding and sharing new insights that relate to both the problem space and solution space relevant to the COE*
- *has senior leaders that embody the value of "learning is never over" through their visible, continual learning in both traditional and new areas of enquiry*
- *has senior leaders who can facilitate appropriate interactions with leading academic and practitioner organizations with the fields relevant to the COE organization*

Criteria

Documented evidence that indicates

- *a current vision statement developed by the organization and its senior leadership has been collaboratively established with COE stakeholders, and is accessible to both internal (program staff) and external (customers and their customers) stakeholders*
- *current mission and function statements have been written in accordance with established standards, and are accessible by external stakeholders as well as program staff*
- *a strategic plan is in place and is being implemented that addresses the organization's vision and strategy for advancement and sustainability*
  - *current performance goals and associated measures traceable to the strategic plan for the COE candidate are in place*
  - *activities to achieve the performance goals are being accomplished*
- *a leadership system has been established that supports the establishment, deployment, and actual activation of the strategic plan, as well as the COE organization's guiding principles and values*
- *appropriate progress and success measures have been established to measure progress against the COE strategic plan; the measures are actively used as part of organizational progress determination*
- *senior leaders regularly review the organization's performance (e.g., innovation, operational, financial, and others) for improvement and to take appropriate action*
- *senior leaders communicate values, vision, directions, key decisions, and expectations through the leadership system to all employees*
- *senior leaders are actively seeking and facilitating appropriate interactions related to the COE topic areas with leading thinkers within both academia and industry*

3.2.1.4 Innovation and Learning Dimension

Key Performance Areas

A COE

- *has the demonstrated and proven ability to incrementally innovate and improve*
- *has the demonstrated and proven ability to anticipate the direction of promising solutions to address the COE's problems*
- *has the demonstrated and proven ability to introduce and gain traction for revolutionary as well as incremental innovations*
- *has the demonstrated and proven ability to develop the transition mechanisms needed to turn innovations into accepted technology improvements*
- *has the demonstrated and proven ability to create and leverage the value network needed to support introduction and deployment of innovations that are relevant to the COE's customers and their customers*
- *has an environment that fosters both incremental and innovative learning*

- *develops, institutionalizes and applies leading-edge technology in the accomplishment of its COE mission*

Criteria

Documented evidence that indicates

- *technical and leadership staff are actively interacting with the thought leaders in the domain of the COE*
- *technical and leadership staff are actively sharing learning from both internal and external interactions across the community of interest represented by the COE*
- *technical staff understand and can successfully apply leading-edge technology innovation and transition processes, tools, and techniques (examples include mapping innovations into an adopter population, establishing and analyzing a value network, and performing organizational readiness analysis for different innovations)*
- *a comprehensive and proactive training program tied to skills and knowledge needed to accomplish the mission is in place and its results are documented*
- *a continuous improvement program is in place integrating improvements in process and new technology for the financial, customer, innovation, and internal business dimensions of the COE*
- *innovation and learning performance is measured, measures analyzed, and results of the analyses stored and made accessible to the key leadership personnel, appropriate stakeholders and program staff*
- *results of analyses have been and are being used for improvement of the COE's processes and products*

3.2.1.5 Financial Dimension

Key Performance Areas

A COE

- *has a financial management system that supports advocating effectively for both incremental and revolutionary innovations, as appropriate for its domain*
- *has an established financial management system that accommodates the organization's needs to accomplish and improve its mission performance*
- *has and implements a financial management system that is sufficiently flexible to accommodate customer needs and changes in customer requirements*
- *has a financial management system that allows appropriate differentiation of non-recurring and recurring costs related to proposed innovations*

Criteria

Documented evidence that indicates

- *a financial management system has been planned and established at sufficient granularity to permit transparency of the financial decisions to the appropriate stakeholders.*

- *associated processes of the financial management system*[6] *have been established and implemented*

- *financial management is being conducted in accordance with applicable laws, regulations, policies, and assigned fiduciary responsibility*
- *long-range planning for fiscal resources is being accomplished on a scheduled, periodic basis*
- *financial information is accurate and available to leadership personnel, internal and external stakeholders, and customers, as appropriate*
- *financial performance has been measured, analyzed, and results of the analyses stored and made accessible to key leadership personnel, and stakeholders as appropriate*
- *Results of analyses have been and are being used for improvement of the financial management system and processes and to manage the COE candidate*

6 Financial performance refers to performance relative to measures of cost, revenue, and market position, including asset utilization, asset growth, and market share. Examples include returns on investments, value added per employee, debt-to-equity ratio, returns on assets, operating margins, cash-to-cash cycle time, other profitability and liquidity measures, and market gains.

4 Scoring Criteria and Evaluation Methodology

4.1 Scoring Criteria

The scoring criteria is shown in Table 1.

Table 1: Scoring Criteria

Score	Results	Definitions
0	No artifacts or other evidence as required by the criteria are available to substantiate implementation or interaction in this dimension.	
10-25	Some artifacts or other evidence as required by the criteria are available to substantiate implementation or interaction in this dimension. Performance in this dimension is below established requirements for the COE.	0 < Some < 25%
25-50	Many artifacts and other evidence required by the criteria are available to substantiate implementation and interaction in this dimension. Performance in this dimension is equal to established requirements for the COE.	25% < Many < 50%
50-85	Most artifacts or other evidence as required by the criteria are available to substantiate effective implementation and interaction in this dimension. Performance in this dimension is equal to or better than established requirements for the COE.	50% < Most < 85%
85-100	Most to all artifacts or other evidence as required by the criteria are available to substantiate exemplary implementation and interaction in this dimension. Performance in this dimension is equal to or better than world-class benchmarks in the domain of the COE.	85% < Most to All < 100%

The levels shown range from “no artifacts or documented evidence” to “most to all” artifacts of documented evidence with increasing levels of performance.

4.2 Evaluation Methodology

The evaluation methodology follows high-level steps of planning, conducting the evaluation, and reporting results. Lower level processes and activities that apply to the evaluation are shown in Table 2.

Table 2: General Evaluation Activities

Phase	Process
Plan and prepare for evaluation	Analyze requirements Develop evaluation plan Select and prepare team Obtain and inventory initial objective evidence
Conduct evaluation	Prepare participants Examine objective evidence Document objective evidence Verify objective evidence Validate objective evidence
Report results	Deliver evaluation results

At least two qualified evaluators must be used for the evaluation process. Qualification is meant to include expertise in the domain of the COE candidate as well as the knowledge of the criteria and evaluation methodology described here.

The rating approach characterizes the achievement and satisfaction of criteria. Rather than simply "checking" for **adherence** to model or standard practices, the COE evaluation method uses the criteria as the evaluation reference model along with the scoring criteria shown in Table 1. That is, for each framework dimension, the evaluation looks for documented evidence of achieving the criteria and rates the achievement by assigning points according to the scoring criteria.

For example, in the dimension of customer focus, if most to all artifacts are present and the performance can be shown to exceed the criteria, including a judgment by the evaluators that the COE is performing at the level of world-class benchmarks in the COE's domain, the evaluators assign 85-100 points depending upon the extent and quality of the documented evidence. While there may be some subjectivity associated with the exact point score assigned, rationale as to why that particular point value was given must be provided.

The evaluators must include a characterization of the quality of the documented evidence as part of the evaluation where quality is defined by the following.

Documented evidence

- describes measures of performance used to substantiate claims for accomplishment of each criterion in the dimension
- provides sufficient details and substantive information to convey the performance achieved for each criterion in the dimension
- exhibits clarity by excluding the use of ambiguous language or words with multiple meanings
- is internally consistent, with no conflicts visible to an external reader across document sections and across all relevant documents and other evidence in the dimension being evaluated

After all dimensions are scored, a generalized Kiviat-type diagram similar to Figure 3 is developed:

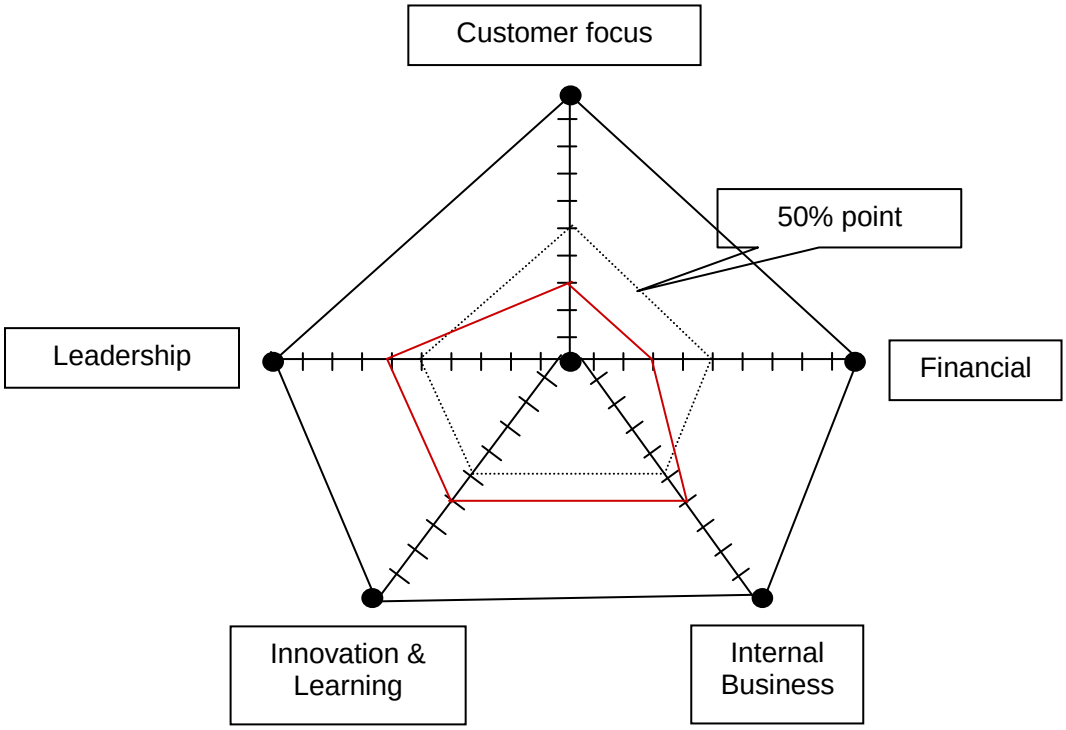

Figure 3: Performance Excellence Scoring

Based on the scoring criteria, 85 or more points would indicate excelling in that dimension. If all dimensions are assigned 85 or more points each, this is an indication that the organization is a COE for its respective domain.

The information resulting from the evaluation is provided to the candidate COE sponsor. The candidate can elevate the findings to the AMC CIO for certification as desired.

5 Summary

The authors developed a framework integrating elements of the balanced scorecard and the Baldrige Criteria for Performance Excellence to form a background for evaluating organizations as centers of excellence. The framework includes definitions, additional characteristics of COEs, associated criteria, an evaluation method, and a presentation format for the results of the evaluation.

The evaluation method follows high-level steps of planning the evaluation, conducting the evaluation, and reporting results. The method employs a set of scoring or rating criteria appropriate to the COE certification process, and format for the presentation of evaluation results.

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.

1. **AGENCY USE ONLY** (Leave Blank)	2. **REPORT DATE** December 2009	3. **REPORT TYPE AND DATES COVERED** Final
4. **TITLE AND SUBTITLE** Generalized Criteria and Evaluation Method for Center of Excellence: A Preliminary Report		5. **FUNDING NUMBERS** FA8721-05-C-0003
6. **AUTHOR(S)** Dr. William Craig, Matthew Fisher, Suzanne Garcia, Clay Kaylor, John Porter, & Lee Reed		
7. **PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)** Software Engineering Institute Carnegie Mellon University Pittsburgh, PA 15213		8. **PERFORMING ORGANIZATION REPORT NUMBER** CMU/SEI-2009-TN-011
9. **SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)** HQ ESC/XPK 5 Eglin Street Hanscom AFB, MA 01731-2116		10. **SPONSORING/MONITORING AGENCY REPORT NUMBER**
11. **SUPPLEMENTARY NOTES**		
12A **DISTRIBUTION/AVAILABILITY STATEMENT** Unclassified/Unlimited, DTIC, NTIS		12B **DISTRIBUTION CODE**

13. **ABSTRACT (MAXIMUM 200 WORDS)**

Centers of Excellence (COEs) are created throughout the federal government in all domains to signify expertise important for elevating the significance of the product or service that is provided. But how are these COEs designated, accredited, or certified? Are there means of auditing, assessing, or appraising them? How do they achieve their "Center of Excellence" appellation? The answer is not clear-cut or without mystery. It is often a matter of trust to accept that the excellence declared in any COE domain exists.

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14. **SUBJECT TERMS** Center of excellence, ISO, assessment	15. **NUMBER OF PAGES** 35
16. **PRICE CODE**	

17. **SECURITY CLASSIFICATION OF REPORT** Unclassified	18. **SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	19. **SECURITY CLASSIFICATION OF ABSTRACT** Unclassified	20. **LIMITATION OF ABSTRACT** UL