**GEN-2 PERFORMANCE CRITERIA**

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| **High Quality Vision & Value Added (Years 1-3)** |  **Low Quality Vision and Value Added (Years 1-3)**  |
| Systems Motivation: Strong systems vision motivates the ERC, early systems requirements understood  | Systems Motivation: Little understanding of engineered systems  |
| Transformational: Vision has potential to transform or significantly impact industry/practitioners, the workforce, and society  | Transformational: Losing sight of the promise of the vision and its potential impact  |
| Leading-edge: Vision positions the ERC to lead in the field  | Leading-edge: ERC lags the state of the art or is already eclipsed by competitors  |
| High Quality Research: Research output is high quality, some deriving from cross-disciplinary collaboration, publications based on ERC research in process  | High Quality Research: Research output is low quality; or if high quality, it resembles the output of a collection of single investigator projects  |
| Industrial Relevance: Some high quality research advances moving into use, most likely to be useful in a few years  | Industrial Relevance: Low probability of impact of the research on industry and practice or, if output is moving into industry, it is low quality or low impact  |
| Educational Impact: ERC research impacting courses and, if part of the strategic plan, impacting curriculum development  | Educational Impact: Little or no impact on courses or curriculum |
| **High Quality Strategic Plan (Years 1-3)** | **Low Quality Strategic Plan (Years 1-3)**  |
| Systems: Systems concepts and technology goals drive and integrate all levels of research  | Systems: The strategic research plan is not motivated by systems concepts and technology goals  |
| Research Integration: Research organized into well-integrated thrusts designed to achieve the vision and redirected as necessary  | Research Integration: Thrust have little relationship to each other or the vision; ineffective thrusts have not been redirected or terminated  |
| Barriers: Strategic plan focuses on significant barriers and challenges that position the research to lead the field and advance the state of the art  | Barriers: Barriers and challenges are not significant and will not result in contributions that will lead the field  |
| Test-beds: Test beds or test bed plans provide a significant opportunity to integrate the research thrusts to explore and prove enabling and systems level technologies  | Test-beds: No evidence of test beds in plans or test beds appear to be demonstrations, isolated from research thrusts or the strategic plan  |
| Cross-disciplinary: The team is appropriately cross-disciplinary with necessary disciplines and sub-disciplines  | Cross-disciplinary: The team is not appropriately cross-disciplinary, necessary disciplines or sub-disciplines are missing |
|  **High Quality Research Program (Thrust Level) (Years 1-3)** |  **Low Quality Research Program (Thrust Level) (Years 1-3)**  |
| Contribution: Thrust and its projects designed to contribute to the goals and vision of the ERC  | Contribution: Thrust has little relevance to the goals and vision of the ERC  |
| Interdependence: Projects are appropriately cross-disciplinary and becoming integrated, growing interdependence of projects within the thrust, appropriate interdependence among thrusts beginning  | Interdependence: Thrust resembles a collection of single investigator projects working in isolation  |
| Methodology: Significant research barriers/challenges being addressed through high quality research methods  | Methodology: Research barriers/challenges are not significant and research methods are not advancing the state of the art  |
| Project Selection: Projects are appropriate to fulfill thrust goals; decisions based on external input when needed, and sufficiently funded; weak or inappropriate projects are terminated  | Project Selection: Projects are not appropriate to fulfill thrust goals; decisions are not based on external input when needed, and are not sufficiently funded; weak or inappropriate projects are not terminated  |
| Team Dynamics: Thrust team is becoming cohesive; opportunities for cross-institutional collaboration being pursued  | Team Dynamics: Faculty no cohesive and/or opportunities for cross-institutional collaboration not pursued  |
| Significant Results: Positioned to or beginning to deliver results that are unique in the field, high quality publications in process, some results due to cross-disciplinary collaboration and insight  | Significant Results: Results do not appear to be unique in the field, could have been achieved by a collection of individual projects  |
| Technology Transfer: Research and technology advances beginning to transfer to industry/practitioners  | Technology Transfer: Little interest on the part of industry/practitioners in the outcome of the research  |
|  **High Quality Education and Educational Outreach (Years 1-3)** |  **Low Quality Education and Educational Outreach (Years 1-3)**  |
| Culture: Cross-disciplinary, cross-institutional education culture is developing  | Culture: Little or no cross-disciplinary, cross-institutional, and/or team-based interaction on the part of faculty and students  |
| Teaming: Undergraduate and graduate students are starting to work in teams; significant commitment to involvement of undergraduates in research (ratio of graduate to undergraduate students of approaching 2:1)  | Teaming: Minimal involvement of undergraduates in research  |
| Curricula: Research results being incorporated in existing courses, and there are specific plans for programs/options  | Curricula: Few if any research results are being integrated into courses for students and/or practitioners, little or no activity related to developing any proposed degree programs/options  |
| Assessment: Strong plans in place to assess and disseminate new education programs and curricular materials  | Assessment: Evaluation/assessment plans poor or they do not exist; personnel involved lack appropriate background for the task  |
| Systems Training: Specific plans in place for formal student training in systems concepts  | Systems Training: Students have little or no awareness of systems issues, no formal training planned  |
| Industry Interaction: Students have ample opportunities to work with industry. practitioners in internships or on sponsored projects  | Industry Interaction: Few of any students work with practitioners at the ERC or in industry  |
| Outreach: Collaborations with female/minority serving partners are effective in increasing ERC's diversity in ERC's education programs  | Outreach: No or ineffective diversity partnerships in education, no commitment to diversity  |
| REU: ERC provides funding to support Research Experiences for Undergraduates. Program provides non-ERC students with an ERC research experience and focuses on underrepresented groups  | REU: Precollege outreach programs are nonexistent, inappropriate or disconnected from the ERC's research and education programs, or no emphasis on diversity  |
| K-12 Outreach and RET: Pre-college outreach includes a Research Experiences for Teachers program and involves K-12 students with an emphasis on increasing the participation of underrepresented groups in engineering  | K-12 Outreach and RET: Education activities in multi-institutional ERCs are not coordinated and are not impacting all the core partner institutions  |
| Cross-institutional Educational Opportunities: A partnership in education among the lead and core partner institutions involves all core partners and impacts their ERC students  | Cross-institutional Educational Opportunities: Education activities between ERC partners are not coordinated and are not impacting all the core partner institutions  |
|  **High Quality Industrial/Practitioner Collaboration & Technology Transfer (Years 1-3)** |  **Low Quality Industrial/Practitioner Collaboration & Technology Transfer (Years 1-3)**  |
| Membership Agreement: Center-wide membership agreement structures the industry collaboration program with clear statements of fees, benefits, and intellectual property policies  | Membership Agreement: Membership agreement not in place; Center IP policies deter industry membership or technology transfer  |
| Membership: Growing or stable group of members across sectors and throughout the supply chain appropriate for the ERC's vision, key players have joined by the third year or are in the process of joining  | Membership: Membership promise of proposal not fulfilled, many of those committed or promising to commit did not sign up, significant numbers of firms/agencies leaving, and/or major sectors are missing  |
| IAB: Industrial Advisory Board (IAB) active and effective and SWOT process yielding cogent advice to the ERC  | IAB: IAB rarely meets, SWOT process not in place or outcome ignored  |
| Industry Integration: Industrial collaboration beginning to achieve a cooperative partnership that is integrated into the ERC's planning, research, and education activities  | Industry Integration: Industry involved only on a project-by-project basis, no collective, collaborative partnership  |
| Membership Fees: Membership fees provide discretionary funds for the ERC, commensurate with typical investments in academic R&D for the sectors represented by the firms involved  | Membership Fees: Low level of membership cash support for discretionary fund  |
| Technology Transfer: Knowledge and technology transfer is starting to impact industry/practitioners  | Technology Transfer: Little knowledge or technology transfer has occurred, the center has had little impact on industry/practitioner |
| **High Quality Infrastructure (Years 1-3)** | **Low Quality Infrastructure (Years 1-3)** |
|  **High Quality Configuration & Leadership Effort (Years 1-3)**  |  **Low Quality Configuration & Leadership Effort (Years 1-3)**  |
| Institutional Configuration: Appropriately integrated institutional configuration among lead, core partner, and outreach institutions, partnership beginning to emerge  | Institutional Configuration: Individual center institutions operating mostly independently of each other  |
| Center Director/Deputy Director: Effective Center Director and Deputy Director, able to implement vision and provide leadership.  | Center Director/Deputy Director: Center Director and/or Deputy Director have not translated vision into operation, leadership skills of one or both are not up to the task  |
| Leadership Team: Other members of the leadership team (research thrusts, education, industrial collaboration, and administration) are becoming cohesive and effective in planning and implementing the research, education, industrial collaboration, and administrative aspects of the ERC  | Leadership Team: Some or all of these leaders are not effective and there are no plans to replace them  |
| Research Team: High quality research team shares the vision, appropriate mix of expertise (faculty, practitioners, and students) to fulfill vision and systems goals  | Research Team: Research team does not share the vision, is low quality, or does not have the mix of expertise necessary to fulfill the vision and systems goals  |
| Student Leadership Council: Student Leadership Council (SLC) in place, starting to effectively lead student programs, SWOT process starting to impact ERC, ERC leaders receptive to the SLC's recommendations for improvement, SLC has adequate resources to achieve its goals  | Student Leadership Council: Student Leadership Council is not effective, doesn't use SWOT analysis  |
|  **High Quality Diversity Effort (Years 1-3)** |  **Low Quality Diversity Effort (Years 1-3)**  |
| Diversity Strategic Plan: Strong strategic plan for diversity in place benchmarked against national engineering averages over the award period, results beginning to demonstrate effectiveness of plan. Strong partnership for diversity with partner deans and department chairs.  | Diversity Strategic Plan: No strategic plan for diversity in place; no evidence of commitment to diversity. No partnership for diversity with administrators. Results demonstrate ineffective plan or effort.  |
| Minority Serving Institution Interactions: In research and education, ERC involves at least one minority or female serving institution, a Louis Stokes Alliance for Minority Participation (LSAMP), and has at least one other connection with an Alliance for Graduation Education of the Professoriate (AGEP), or institutions that involved Native Americans, etc.  | Minority Serving Institution Interactions: No effort or unsuccessful efforts to involve institutions / NSF diversity awardees that serve women and other underrepresented groups  |
| Leadership Diversity: Team of leaders is diverse in gender, race, and ethnicity  | Leadership Diversity: Little or no commitment to diversity at the leadership level  |
| Women Faculty Involvement: A significant number of women faculty involved, active recruitment continues  | Women Faculty Involvement: None or a small number of women faculty involved since center inception even though candidates available  |
| Underrepresented Minority Faculty Involvement: A significant number of underrepresented minority faculty involved, active recruitment continues  | Underrepresented Minority Faculty Involvement: None or a small number of underrepresented minority faculty involved even though candidates available  |
| Underrepresented Students: Graduate and undergraduate women and underrepresented minority students broadly involved in center activities  | Underrepresented Students: Few or no women and underrepresented minority students appear to be involved in center activities  |
| Involvement of Persons with Disabilities: Efforts are underway to increase the involvement of persons with disabilities at all levels and provide them with appropriate support/access to carry out their work  | Involvement of Persons with Disabilities: Little understanding of how to attract and recruit persons with disabilities to the ERC or if they are there, they have poor support and access to carry out their work |
| **High Quality Management Effort (Years 1-3)** | **Low Quality Management Effort (Years 1-3)**  |
| Management Systems: Effective management systems, goals are set and met or revised, effective use of performance indicators to track and improve performance  | Management Systems: Management systems weak, poor goal setting and delivery, management ignores indicators of poor performance  |
| Use of Financial Resources: Effective use of financial resources to achieve the ERC's goals, thrust and institution level budgets are appropriate for their roles in the ERC, timely allocation of funds; after year one, any residuals should be below 20% of NSF support | Use of Financial Resources: Allocation of resources not commensurate with achieving the ERC's goals, long delays in allocation of funds; after year one, any annual residuals are significantly greater than 20% of NSF  |
| Outside Input: Effective incorporation of outside input in planning, project review, and assessment after year one, any annual residuals should be below 20% of NSF support  | Outside Input: Planning and project review are conducted mostly or exclusively within the ERC and minimal outside input or outside input is ignored  |
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| **High Quality Resources & University Commitment (Years 1-3)** | **Low Quality Resources and University Commitment (Years 1-3)**  |
| Equipment/Facilities: High quality experimental and enabling equipment/facilities; test beds under development according to strategic research plan  | Equipment/Facilities: Experimental and/or enabling equipment/facilities lack critical components, are not state-of the art, or test bed development not proceeding in accordance with strategic research plan  |
| Communications Capability: Headquarters and communications network facilitate interaction among students, faculty, industry/users and participating institutions  | Communications Capability: Headquarters and communications network are ineffective or don't serve to serve to integrate the faculty and students  |
| University Administration: Effective partnership with university administration facilitates the success of the Center through policies that encourage its cross-disciplinary configuration, diversity, and the partnership with industry; deans and department heads committed to success  | University Administration: University administration does not facilitate the cross-disciplinary configuration, diversity, or industrial partnership of the Center, deans and department heads not addressing identified weaknesses of Center  |
| Funds: Funds provided by industry/users, university, and other non-NSF sources are commensurate with their ability to contribute and benefit  | Funds: Support levels for most or all sectors are below what would be expected  |

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| **High Quality Systems Vision & Value Added** **(Years 4-6)**  | **Low Quality Systems Vision & Value Added** **(Years 4-6)**  |
| Systems Motivation: Strong transformational systems vision is fully operational as a motivator for the ERC, systems requirements understood, vision is evolving as appropriate  | Systems Motivation: Systems vision does not motivate the ERC or it has been achieved already; no compelling challenges remaining  |
| Transformational: Vision is transforming or significantly impacting industry/practitioners, the workforce, and society  | Transformational: Losing sight of the promise of the vision and its  |
| Leading-edge: Center is recognized as one of the leaders in the field because of its cross-disciplinary, systems level vision and significant output  | Leading-edge: Center is behind leaders in the field and center contributions are rarely recognized by the field as significant potential impact  |
| High Quality Research: Research output is high quality and largely derived from cross-disciplinary collaboration, extensive cross-disciplinary publications in important journals  | High Quality Research: Research output is low quality; or if high quality, it resembles the output of a collection of single investigator projects  |
| Industrial Relevance: ERC is producing broad-based and unique impact on technology (inventions, licenses, technology in use in industry or other arenas)  | Industrial Relevance: ERC has largely failed to impact technology and practice  |
| Educational Impact: Significant course and curriculum impacts derived from the ERC's research | Educational Impact: Curricular impact is minimal or could have been achieved without the ERC |
| **High Quality Strategic Research Plan (Years 4-6)**  | **Low Quality Strategic Research Plan (Years 4-6)**  |
| Systems: Systems and technology goals have matured and integrated all levels of research, and will continue to evolve appropriately  | Systems: Systems and technology goals have not matured or evolved as necessary; research levels are not integrated  |
| Research Integration: Research effectively organized into well integrated thrusts that contribute to the vision, results being used within and across thrusts  | Research Integration: Thrusts have little relationship to each other and the vision; ineffective thrusts have not been redirected or terminated  |
| Barriers: Strategic plan focuses on remaining significant barriers and challenges, many initial barriers have been overcome, research leads the field and advances the state of the art  | Barriers: Little progress toward overcoming barriers and challenges, identified barriers and challenges are not significant or relevant to the vision, research is lagging the field  |
| Test-beds: Test beds effectively integrate the research to explore and prove enabling and systems level technologies  | Test-beds: No test beds underway or are not integrated with the research thrusts  |
| Cross-disciplinary: The team is appropriately cross-disciplinary with strong interdependence between disparate disciplines and sub-disciplines  | Cross-disciplinary: Team is not sufficiently cross disciplinary, necessary disciplines or sub-disciplines are missing, no interdependence evident  |
| **High Quality Research Program (Thrust Level) (Years 4-6)**  | **Low Quality Research Program (Thrust Level) (Years 4-6)**  |
| Contribution: Thrust and its projects contribute significantly to the goals and vision of the ERC  | Contribution: Thrust has little relevance to the goals and vision of the ERC  |
| Interdependence: Projects are appropriately cross-disciplinary and integrated, interdependence of projects within the thrust, robust interdependence among thrusts  | Interdependence: Thrust resembles a collection of single investigator projects, most or all projects are isolated from one another, thrust is isolated from the others  |
| Methodology: Prior and current significant research barriers/challenges effectively addressed through high quality research methods  | Methodology: Research barriers/challenges are not significant or have not been effectively addressed; or research methods are not advancing the state of the art  |
| Project Selection: Projects are appropriate to fulfill thrust goals; decisions based on external input when needed, and sufficiently funded; weak or inappropriate projects are terminated  | Project Selection: Projects are not appropriate to fulfill thrust goals; decisions are not based on external input when needed, and are not sufficiently funded; weak or inappropriate projects are not terminated  |
| Project Management: Research projects managed over time through different students and dissertations to achieve thrust and ERC deliverables  | Project Management: Thrusts projects result in a collection of individual dissertations with little or no integration or synergy over time  |
| Team Dynamics: Thrust team is cohesive, opportunities for cross-institutional collaboration effectively implemented  | Team Dynamics: Faculty not cohesive and/or opportunities for cross-institutional collaboration not pursued  |
| Significant Results: Delivering results that are unique in the field, high quality publications in journals important for the field, many results are due to cross-disciplinary collaboration and insight  | Significant Results: Results do not appear to be unique in the field, could have been achieved by a collection of individual projects, minimal publications resulting from cross-disciplinary collaboration  |
| Technology Transfer: Results significantly impacting industry/practitioners (patents, licenses, technology transferred to industry and practice)  | Technology Transfer: Results are not advancing technology/processes/procedures for industry/practitioners  |
| **High Quality Education/Educational Outreach (Years 4-6)**  | **Low Quality Education/Educational Outreach** **(Years 4-6)**  |
| Culture: Cross-disciplinary, cross-institutional education culture in place  | Culture: Little or no cross-disciplinary, cross-institutional, and/or team-based interaction on the part of faculty and students |
| Teaming: Undergraduate and graduate students work in teams; ratio of graduate to undergraduate students of approximately 2:1  | Teaming: Minimal involvement of undergraduates in research  |
| Curricula: Research results continue to be incorporated in existing courses, and some new courses or degree programs/options are being implemented  | Curricula: Few if any research results are being integrated into courses for students and/or practitioners, little or no activity related to implementing new courses or degree programs/options  |
| Assessment: New education programs and curricular materials are being assessed and disseminated, including summative and formative evaluations  | Assessment: New education programs and curricular materials have not been assessed; personnel involved lack appropriate background for the task  |
| Systems Training: Students have opportunities for formal training in systems integration  | Systems Training: Students have little or no awareness of systems issues, no formal training in place  |
| Industry Interaction: Many students have had opportunities to work with industry/practitioners through internships or sponsored projects, several hired by member firms  | Industry Interaction: Few if any students have worked or had opportunities to work with industry/practitioners  |
| Outreach for Diversity: Collaborations with female/minority serving partners have resulted in progressively increasing diversity in ERC's education programs over time  | Outreach for Diversity: No or ineffective collaborations with female/minority serving partners or no trends over time that increase diversity in ERC's education programs  |
| REU: ERC provides funding to support Research Experiences for Undergraduates. Program provides non-ERC students with an ERC research experience and focuses on underrepresented groups  | REU: ERC failed to provide an REU program or the students involved in its REU program are not diverse  |
| K-12 Outreach and RET: Pre-college outreach includes an effective Ret program and effectively involves K-12 students with an emphasis on increasing the participation of underrepresented groups in engineering  | K-12 Outreach and RET: Pre-college outreach or RET programs are nonexistent, inappropriate or disconnected from the ERC's research and education programs, or there is no emphasis on increasing the participation of underrepresented groups in engineering  |
| Cross-institutional Educational Opportunities: A partnership in education among the lead and core partner institutions involves all core partners and impacts their ERC students  | Cross-institutional Educational Opportunities: Education activities between ERC partners are not coordinated and are not impacting all the core partner institutions  |
| **High Quality Industrial/Practitioner Collaboration and Technology Transfer (Years 4-6)** | **Low Quality Industrial/Practitioner Collaboration and Technology Transfer (Years 4-6)** |
| Membership Agreement: Center-wide membership agreement structures the industry collaboration program with clear statements of fees, benefits, and intellectual property policies that promote technology transfer  | Membership Agreement: Membership agreement not in place; Center IP policies deter industry membership or technology transfer  |
| Membership: Growing or stable group of members across sectors and throughout the supply chain appropriate for the ERC's vision. Key players are members.  | Membership: Membership promise of proposal not fulfilled, many of those committed or promising to commit did not sign up, significant numbers of firms/agency are leaving, and/or major sectors are missing  |
| IAB: Industrial Advisory Board (IAB) active and effective; SWOT process yielding cogent advice to the ERC  | IAB: IAB rarely meets, SWOT process not in place or outcome ignored  |
| Industry Integration: Industrial collaboration has become a cooperative partnership that is integrated into the ERC's planning, research, and education activities  | Industry Integration: Industry involved only on a project-by-project basis, no collective, collaborative partnership  |
| Membership Fees: Membership fees provide discretionary funds for the ERC and commensurate with typical investments in academic R&D for the sectors represented by the firms involved  | Membership Fees: Low level of membership cash support for discretionary fund  |
| Technology Transfer: Knowledge and technology transfer is impacting industry/practitioners  | Technology Transfer: Little knowledge or technology transfer has occurred, the center has had little impact on industry/practitioner  |
| **High Quality Infrastructure (Years 4-6)**  | **Low Quality Infrastructure (Years 4-6)**  |
|  **High Quality Configuration & Leadership Effort (Years 4-6)** |  **Low Quality Configuration & Leadership Effort Years (Years 4-6)**  |
| Institutional Configuration: Appropriately integrated institutional configuration among lead, core partner, and outreach institutions, partnership strong  | Institutional Configuration: Individual center institutions operating mostly independently of each other  |
| Center Director/Deputy Director: Highly effective Center Director and Deputy Director, have implemented vision and are providing capable leadership for the ERC and the university  | Center Director/Deputy Director: Center Director and/or Deputy Director have not translated vision into operation, leadership skills of one or both are not up to the task  |
| Leadership Team: Other members of the leadership team (research thrusts, education, industrial collaboration, SLC, and administration) are cohesive and effective in planning and implementing the research, education, industrial collaboration, and administrative aspects of the ERC  | Leadership Team: Some or all of these leaders are not effective and there are no plans to replace them  |
| Research Team: High quality integrated research team shares the vision, appropriate mix of expertise (faculty, practitioners, and students) to fulfill vision and systems goals  | Research Team: Research team does not share the vision, is low quality, or does not have the mix of expertise necessary to fulfill the vision and systems goals, or operating independently  |
| Student Leadership Council: Student Leadership Council (SLC) in place, is effectively leading student programs, SWOT process is impacting ERC, ERC leaders are receptive to the SLC's recommendations for improvement, SLC has adequate resources to achieve its goals  | Student Leadership Council: Student Leadership Council is not effective, doesn't use SWOT analysis, ERC leaders not receptive to SLC recommendations |
| **High Quality Diversity Effort (Years 4-6)** | **Low Quality Diversity Effort (Years 4-6)**  |
| Diversity Strategic Plan: Strong strategic plan for diversity in place benchmarked against national engineering averages over the award period, results demonstrate a strong and effective plan. Strong partnership for diversity with partner deans and department chairs.  | Diversity Strategic Plan: Ineffective strategic plan for diversity in place; no evidence of commitment to diversity. No partnership for diversity with administrators. Results demonstrate ineffective plan or effort.  |
| Minority Serving Institution Interactions: In research and education, ERC involves at least one minority or female serving institution, a Louis Stokes Alliance for Minority Participation (LSAMP), and has at least one other connection with an Alliance for Graduation Education of the Professoriate (AGEP), or institutions that involved Native Americans, etc. | Minority Serving Institution Interactions: No effort or unsuccessful efforts to involve institutions / NSF diversity awardees that serve women and other underrepresented groups |
| Leadership Diversity: Team of leaders is diverse in gender, race, and ethnicity institution.  | Leadership Diversity: Little or no commitment to diversity at the leadership level  |
| Women Faculty Involvement: A significant number of women faculty involved, active recruitment continues  | Women Faculty Involvement: None or a small number of women faculty involved since center inception even though candidates available  |
| Underrepresented Minority Faculty Involvement: A significant number of underrepresented minority faculty involved, active recruitment continues  | Underrepresented Minority Faculty Involvement: None or a small number of underrepresented minority faculty involved even though candidates available  |
| Underrepresented Students: Graduate and undergraduate women and underrepresented minority students broadly involved in center activities  | Underrepresented Students: Few or no women and underrepresented minority students appear to be involved in center activities  |
| Involvement of Persons with Disabilities: Efforts are underway to increase the involvement of persons with disabilities at all levels and provide them with appropriate support/access to carry out their work  | Involvement of Persons with Disabilities: Little understanding of how to attract and recruit persons with disabilities to the ERC or if they are there, they have poor support and access to carry out their work |
| **High Quality Management Effort (Years 4-6)** | **Low Quality Management Effort (Years 4-6)**  |
| Management Systems: Effective management systems, goals are set and met or revised, effective use of performance indicators to track and improve performance  | Management Systems: Management systems weak, poor goal setting and delivery, management ignores indicators of poor performance  |
| Use of Financial Resources: Effective use of financial resources to achieve the ERC's goals, thrust and institution level budgets are appropriate for their roles in the ERC, timely allocation of funds, any annual residuals are below 20% of NSF support  | Use of Financial Resources: Allocation of resources not commensurate with achieving the ERC's goals, long delays in allocation of funds, any annual residuals are significantly greater than 20% of NSF support  |
| Outside Input: Effective incorporation of outside input in planning, project review, and assessment  | Outside Input: Planning and project review are conducted mostly or exclusively within the ERC and minimal outside input or outside input is ignored  |
| Post-graduation: By year 5, realistic and sound initial plan for financial self-sufficiency when NSF support ceases  | Post-graduation: Weak plan for financial self-sufficiency when NSF support ceases |
|  **High Quality Resources & University Commitment (Years 4-6)** |  **Low Quality Resources and University Commitment (Years 4-6)**  |
| Equipment/Facilities: High quality experimental and enabling equipment/facilities; test beds operating according to strategic plan  | Equipment/Facilities: Experimental and/or enabling equipment/facilities lack critical components, are not state-of the art, or test bed development is not proceeding according to plan  |
| Communications Capability: Headquarters and communications network facilitate interaction among students, faculty, industry/users and participating institutions  | Communications Capability: Headquarters and communications network are effectively non-existent  |
| University Administration: Effective partnership with university administration facilitates the success of the Center through policies that encourage its cross-disciplinary configuration, its diversity, and its partnership with industry; deans and department heads committed to success  | University Administration: University administration does not facilitate the cross-disciplinary configuration, diversity, or industrial partnership of the Center, deans and department heads not involved  |
| Funds: Investment made by industry/users, university, and other non-NSF investors commensurate with their ability to contribute and benefit  | Funds: Most or all sectors are below what would be expected  |

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| **High Quality Strategic Vision and Value Added** **(Years 7-10)**  | **Low Quality Strategic Vision and Value Added** **(Years 7-10)**  |
| Systems Motivation: Systems vision more challenging and evolving to sustain ERC past graduation | Systems Motivation: Systems vision has been lost or the systems vision has been fulfilled already |
| Transformational: Vision has transformed or significantly impacted industry/practitioners, the workforce and society  | Transformational: Vision has resulted in little or no impact on industry/practitioners, the workforce, or society  |
| Leading-edge: Center is recognized as one of the leaders in the field because of its cross-disciplinary, systems level vision and significant output  | Leading-edge: Center is behind leaders in the field and center contributions are rarely recognized by the field as significant has been fulfilled already  |
| High Quality Research: Research output is high quality and largely derived from cross-disciplinary collaboration, extensive cross-disciplinary publications in important journals  | High Quality Research: Research output is low quality; or if high quality, it resembles the output of a collection of single investigator projects  |
| Industrial Relevance: ERC is producing broad-based and unique impact on technology (inventions, licenses, technology in use in industry or other arenas)  | Industrial Relevance: ERC has largely failed to impact technology and practice  |
| Educational Impact: Significant course and curriculum impacts derived from the ERC research  | Educational Impact: Curricular impact is minimal and could have been achieved without the ERC  |
| **High Quality Strategic Research Plan (Years 7-10)**  | **Low Quality Strategic Research Plan (Years 7-10)**  |
| Systems: Systems and technology goals are mature and have integrated all levels of research, appropriate evolution continues  | Systems: Systems and technology goals have not matured or evolved as necessary; research levels are not integrated.  |
| Research Integration: Research effectively organized into well-integrated thrusts that contribute to the vision, results being used within and across thrusts, integrated thrusts continue to evolve to sustain the ERC past graduation  | Research Integration: Thrusts have little relationship to each other and the vision; ineffective thrusts have not been redirected or terminated  |
| Barriers: Strategic plan focuses on remaining significant barriers and challenges, initial barriers have been overcome, research leads the field and continues to advance the state of the art  | Barriers: Limited progress toward overcoming barriers and challenges, remaining barriers and challenges are not significant or relevant to the vision, research is lagging the field  |
| Test-beds: Test bed(s) operational, effectively integrating the research to explore and prove enabling and systems level technologies  | Test-beds: No test beds operational or are not integrated with the research results  |
| Cross-disciplinary: The team is appropriately cross-disciplinary with strong interdependence between disparate disciplines and sub-disciplines  | Cross-disciplinary: Team is not sufficiently cross disciplinary, necessary disciplines or sub-disciplines are missing, no interdependence evident or opportunities have been missed because they did not achieve interdependence  |
| **High Quality Research Program (Thrust Level) (Years 7-10)**  | **Low Quality Research Program (Thrust Level)** **(Years 7-10)**  |
| Contribution: Thrust and its projects contribute significantly to the goals and vision of the ERC  | Contribution: Thrust has little relevance to the goals and vision of the ERC  |
| Interdependence: Projects are appropriately cross-disciplinary and integrated, interdependence of projects within the thrust, robust interdependence among thrusts  | Interdependence: Thrust resembles a collection of single investigator projects, most or all projects are isolated from one another, thrust is isolated from others  |
| Methodology: Prior and current significant research barriers/challenges effectively addressed through high quality research methods  | Methodology: Research barriers/challenges are not significant or have not been effectively addressed; or research methods are not advancing the state of the art  |
| Project Selection: Projects are appropriate to fulfill thrust goals; decisions based on external input when needed, and sufficiently funded; weak or inappropriate projects are terminated  | Project Selection: Projects are not appropriate to fulfill thrust goals; decisions are not based on external input when needed, and are not sufficiently funded; weak or inappropriate projects are not terminated  |
| Project Management: Research projects managed over time, and through NSF phase down and into self-sufficiency, through different students and dissertations to achieve thrust and ERC deliverables  | Project Management: Thrust projects result in a collection of individual dissertations with little or no integration or synergy over time, or no planning for NSF phase down or post-NSF support  |
| Team Dynamics: Thrust team is cohesive, opportunities for cross-institutional collaboration effectively implemented  | Team Dynamics: Faculty not cohesive and/or opportunities for cross-institutional collaboration not pursued  |
| Significant Results: Delivering results that are unique in the field, high quality publications in journals important for the field, many results are due to cross-disciplinary collaboration and insight  | Significant Results: Results do not appear to be unique in the field, could have been achieved by a collection of individual projects, minimal publications resulting from cross-disciplinary collaboration  |
| Technology Transfer: Results significantly impacting industry/practitioners (patents, licenses, technology transferred to industry and practice)  | Technology Transfer: Results are not advancing technology/ processes/ procedures for industry/practitioners  |
| **High Quality Education/Educational Outreach** **(Years 7-10)**  | **Low Quality Education/Educational Outreach** **(Years 7-10)**  |
| Culture: Cross-disciplinary, cross-institutional education culture flourishing with impacts beyond the ERC  | Culture: Little or no cross-disciplinary, cross-institutional, and/ or team-based interaction on the part of faculty and students  |
| Teaming: Undergraduate and graduate students work in teams; ratio of graduate to undergraduate students of approximately 2:1  | Teaming: Minimal involvement of undergraduates in research  |
| Curricula: Research results continue to be incorporated in existing courses, and some new courses or degree programs/options are being implemented ERC continues to produce high quality educational output based on its research with a significant impact on the curriculum (impact on courses is required, new degree programs/options are optional) for undergraduate and graduate students and practitioners  | Curricula: Few if any research results have been integrated into courses for students and practitioners, little or no activity related to any proposed degree programs/options  |
| Assessment: New education programs and curricular materials continue to be assessed and disseminated, including summative and formative evaluations  | Assessment: New education programs and curricular materials have not been assessed; personnel involved lack appropriate background for the task  |
| Systems Training: Students have opportunities for formal training in systems integration  | Systems Training: Students have little or no awareness of systems issues, no formal training in place  |
| Industry Interaction: Students continue to have ample opportunities to work with industry/practitioners through internships or sponsored projects, several hired by member firms  | Industry Interaction: Few if any students have worked or had opportunities to work with industry/practitioners  |
| Outreach: Collaborations with female/minority serving partners have resulted in progressively increasing diversity in ERC's education programs over time  | Outreach: No or ineffective collaborations with female/minority serving partners or no trends over time that increase diversity in ERC's education programs  |
| REU: ERC provides funding to support Research Experiences for Undergraduates. Program provides non-ERC students with an ERC research experience and focuses on underrepresented groups  | REU: ERC failed to provide an REU program or the students involved in its REU program are not diverse  |
| K-12 Outreach and RET: Pre-college outreach includes an effective RET program and effectively involves K-12 students with an emphasis on increasing the participation of underrepresented groups in engineering  | K-12 Outreach and RET: Pre-college outreach or RET programs are nonexistent, inappropriate or disconnected from the ERC's research and education programs, or there is no emphasis on increasing the participation of underrepresented groups in engineering  |
| Cross-institutional Educational Opportunities: A partnership in education among the lead and core partner institutions involves all core partners and impacts their ERC students  | Cross-institutional Educational Opportunities: Education activities between ERC partners are not coordinated and are not impacting all the core partner institutions  |
| **High Quality Industrial/Practitioner Collaboration and Technology Transfer (Years 7-10)**  | **Low Quality Industrial/Practitioner Collaboration and Technology Transfer (Years 7-10)**  |
| Membership Agreement: Center-wide membership agreement structures the industry collaboration program with clear statements of fees, benefits, and intellectual property policies that promote technology transfer  | Membership Agreement: Membership agreement not in place; Center IP policies deter industry membership or technology transfer  |
| Membership: Growing or stable group of members across sectors and throughout the supply chain appropriate for the ERC's vision. Key players are members, members strongly committed to supporting the ERC after graduation  | Membership: Membership promise of proposal not fulfilled, many of those committed or promising to commit did not sign up, significant numbers of firms/agency are leaving, and/or major sectors are missing, little commitment to the ERC after graduation  |
| IAB: Industrial Advisory Board (IAB) active and effective; SWOT process yielding cogent advice to the ERC  | IAB: IAB rarely meets, SWOT process not in place or outcome ignored  |
| Industry Integration: Industrial collaboration has become a cooperative partnership that is integrated into the ERC's planning, research, and education activities  | Industry Integration: Industry involved only on a project-by-project basis, no collective, collaborative partnership  |
| Membership Fees: Membership fees provide discretionary funds for the ERC and commensurate with typical investments in academic R&D for the sectors represented by the firms involved  | Membership Fees: Low level of membership cash support for discretionary fund  |
| Technology Transfer: Knowledge and technology transfer is impacting industry/practitioners  | Technology Transfer: Little knowledge or technology transfer has occurred, the center has had little impact on industry/practitioner  |
| **High Quality Infrastructure (Years 7-10)**  | **Low Quality Infrastructure (Years 7-10)** |
|  **High Quality Configuration & Leadership Effort (Years 7-10)** | **Low Quality Configuration & Leadership Effort Years (Years 7-10)**  |
| Institutional Configuration: Appropriately integrated institutional configuration among lead, core partner, and outreach institutions, partnership strong  | Institutional Configuration: Individual center institutions operating mostly independently of each other  |
| Center Director/Deputy Director: Highly effective Center Director and Deputy Director, have implemented vision and are providing capable leadership for the ERC and the university, effectively structuring the ERC for graduation  | Center Director/Deputy Director: Center Director and/or Deputy Director have not translated vision into operation, leadership skills of one or both are not up to the task, little or no leadership evident regarding survival of ERC after graduation  |
| Leadership Team: Other members of the leadership team (research thrusts, education, industrial collaboration, SLC, and administration) are cohesive and effective in planning and implementing the research, education, industrial collaboration, and administrative aspects of the ERC  | Leadership Team: Some or all of these leaders are not effective and there are no plans to replace them  |
| Research Team: High quality integrated research team shares the vision, appropriate mix of expertise (faculty, practitioners, and students) to fulfill vision and systems goals  | Research Team: Research team does not share the vision, is low quality, or does not have the mix of expertise necessary to fulfill the vision and systems goals, or operating independently  |
| Student Leadership Council: Student Leadership Council (SLC) in place, is effectively leading student programs, SWOT process is impacting ERC, ERC leaders are receptive to the SLC's recommendations for improvement, SLC has adequate resources to achieve its goals  | Student Leadership Council: Student Leadership Council is not effective, doesn't use SWOT analysis, turnover in leadership not smooth, ERC leaders not receptive to SLC recommendations |
| **High Quality Diversity Effort (Years 7-10)** | **Low Quality Diversity Effort (Years 7-10 )**  |
| Diversity Strategic Plan: Strong strategic plan for diversity in place benchmarked national engineering averages, results demonstrate continued effectiveness of plan. Strong partnership for diversity with partner deans and department chairs.  | Diversity Strategic Plan: Ineffective strategic plan for diversity in place; no evidence of commitment to diversity. No partnership for diversity with administrators.  |
| Minority Serving Institution Interactions: In research and education, ERC involves at least one minority or female serving institution, a Louis Stokes Alliance for Minority Participation (LSAMP), and has at least one other connection with an Alliance for Graduation Education of the Professoriate (AGEP), or institutions that involved Native Americans, etc. | Minority Serving Institution Interactions: Ineffective or unsuccessful efforts to involve institutions / NSF diversity awardees that serve women and other underrepresented groups  |
| Leadership Diversity: Team of leaders is diverse in gender, race, and ethnicity  | Leadership Diversity: Little or no commitment to diversity at the leadership level  |
| Women Faculty Involvement: A significant number of women faculty involved, active recruitment continues  | Women Faculty Involvement: None or a small number of women faculty involved since center inception even though candidates available  |
| Underrepresented Minority Faculty Involvement: A significant number of underrepresented minority faculty involved, active recruitment continues  | Underrepresented Minority Faculty Involvement: None or a small number of underrepresented minority faculty involved even though candidates available  |
| Underrepresented Students: Graduate and undergraduate women and underrepresented minority students broadly involved in center activities  | Underrepresented Students: Few or no women and underrepresented minority students appear to be involved in center activities  |
| Involvement of Persons with Disabilities: Efforts are underway to increase the involvement of persons with disabilities at all levels and provide them with appropriate support/access to carry out their work  | Involvement of Persons with Disabilities: Little understanding of how to attract and recruit persons with disabilities to the ERC or if they are there, they have poor support and access to carry out their work |
| **High Quality Management Effort (Years 7-10)** | **Low Quality Management Effort (Years 7-10)** |
| Management Systems: Effective management systems, goals are set and met or revised, effective use of performance indicators to track and improve performance  | Management Systems: Management systems weak, poor goal setting and delivery, management fails to correct poor performance  |
| Use of Financial Resources: Effective use of financial resources to achieve the ERC's goals, thrust and institution level budgets are appropriate for their roles in the ERC, timely allocation of funds, any annual residuals are below 20% of NSF support  | Use of Financial Resources: Allocation of resources not commensurate with achieving the ERC's goals, long delays in allocation of funds, any annual residuals are significantly greater than 20% of NSF support  |
| Outside Input: Effective incorporation of outside input in planning, project review, and assessment  | Outside Input: Planning and project review are conducted mostly or exclusively within the ERC and minimal outside input or outside input is ignored  |
| Post-Graduation: Realistic and sound business plan for financial self-sufficiency when NSF support ceases  | Post-Graduation: Weak or unrealistic business plan or none in place for financial self-sufficiency when NSF support ceases  |
| **High Quality Resources & University Commitment (Years 7-10)** |  **Low Quality Resources and University Commitment (Years 7-10)**  |
| Equipment/Facilities: High quality experimental and enabling equipment/facilities; test beds effective  | Equipment/Facilities: Experimental and/or enabling equipment/facilities lack critical components, are not state-of the art, or test bed development is not evident  |
| Communications Capability: Headquarters and communications network facilitate interaction among students, faculty, and industry/users and participating institutions  | Communications Capability: Headquarters and communications network are effectively non-existent  |
| University Administration: Effective partnership with university administration facilitates the success of the Center through policies that encourage its cross-disciplinary configuration, its diversity, and its partnership with industry; deans and department heads committed to success  | University Administration: University administration does not facilitate the cross-disciplinary configuration, diversity, or industrial partnership of the Center, deans and department heads not involved  |
| Funds: Investment made by industry/users, university, and other non-NSF investors commensurate with their ability to contribute and benefit  | Funds: Most or all sectors are below what would be expected  |

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| **Early Testbed** |
| **High Quality Testbed** | **Low Quality Testbed** |
| Testbed Requirements and Metrics The ERC has begun to define requirements for the testbed derived from the vision and systems goals of the ERC | Testbed Requirements and MetricsRequirements for the testbed are not in line with the systems goals of the ERC  |
| Technology Integration Testbeds are designed to prove the feasibility of the ERC’s vision and implemented to probe the research by testing the enabling technology, including devices, modules or subsystem components. | Technology IntegrationThe testbed are not designed to effectively prove the feasibility of the enabling technology, including devices, modules or subsystem components, in a system-like environment. |
| Function in Research: The testbed is serving as a versatile experimentation site, through which the performance of novel technologies are measured and results are fed back into the research thrusts to stimulate improvements or generate new research directions. ERCs equipped with several testbeds have ensured complementary functionalities and exchange across testbeds. | Function in Research:The testbed is not serving as a versatile experimentation site for novel technologies, and / or the measured performance of modules is not fed back into the research thrusts to stimulate improvements or generate new research directions. Testbeds are duplicating testing functions. |
| Guidance: Testbeds requirements and metrics are reviewed on a yearly basis by the ERC team with input from the IAB, SAB, or other appropriate user inputs, i.e. clinicians or local government users, etc.  | Guidance:The testbed is not reviewed on a yearly basis by the ERC team with input from the IAB, SAB, and other appropriate user inputs, i.e. clinicians or local government users, etc.  |
| Role in Education: Testbeds are providing students with hands-on experience in “building” technology, integrating devices and components, or testing system-level performance. | Role in Education:Testbeds are not providing students with experience in “building” technology, integrating devices and components, or testing system-level performance. |
| Assessment: Through the definition of objective, stage-appropriate metrics, successful technologies are being identified and analyzed; the testbed is designed as a tool for comparing and validating the research approach(es).  | Assessment:The testbed is not being used as a tool for comparing and validating the research approach(es). |
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| **Developing Testbed** |
| **High Quality Testbed** | **Low Quality Testbed** |
| Testbed Requirements and Metrics: With a set of performance metrics in place, the ERC has successfully implemented some of its near-term testbed milestones. In response to milestone accomplishments, testbed requirements are being refined to be consistent with the vision and system goals of the ERC. Long term testbed goals continue to push the state-of-the-art. | Testbed Requirements and Metrics: The ERC has not achieved any of its testbed milestones nor refined the requirements for the testbeds, to meet the vision and systems goals of the ERC. |
| Technology Integration: The testbed is utilized to probe the research by testing the enabling technology at its different levels of maturity, including devices, modules or subsystem components in a system-like environment. | Technology Integration: Testbeds are not utilized to probe the research by testing the enabling technology, including devices and subsystem components in a system-like environment. |
| Function in Research: The testbeds serve as a versatile experimentation site, through which the performance of component technologies may be measured and/or compared with competing technologies and results are fed back into the research thrusts to stimulate improvements or generate new research directions. | Function in Research: The testbeds are not serving as a versatile experimentation site, through which the performance of component technologies may be measured and/or compared with competing technologies. The collected data is not fed back into the research thrusts to stimulate improvement s or generate new research directions. |
| Technology Translation: Testbed results are improving confidence in the technology’s performance and reproducibility, highlighting relevant applications. The testbed data collection is designed to help facilitate potential technology translation opportunities. | Technology Translation: Testbed results are not improving confidence in the technology’s performance and reproducibility. The data collected in the testbed is not used to highlight relevant applications or facilitate potential technology translation. |
| Guidance: Testbeds are reviewed on a yearly basis by the ERC team with input from the IAB, SAB, and other appropriate user input, i.e. clinicians or local government users, etc.  | Guidance: Testbeds are not reviewed on a yearly basis by the ERC team with input from the IAB, SAB, or other appropriate user inputs, such as clinicians or local government users, etc.  |
| Role in Education: Testbeds are providing students with hands-on experience in “building” technology that result in peer reviewed publications or conference presentations. Hands-on experience includes integrating devices and components, or testing system-level performance. | Role in Education: Testbeds are not providing students with experience in “building” technology, integrating devices and components, or testing system-level performance. Very few opportunities for students to present at conferences are coming out of the testbed research. |
| Assessment: Through the refining of objective, stage-appropriate metrics, successful technologies are being identified and pursued; the testbed has become a tool for comparing and validating the research approach(es). Accomplishments are benchmarked against the state-of-the-art. | Assessment: The testbed has not become a tool for identifying successful technologies nor comparing and validating the research approach(es). Testbed results are not relevant to the state-of-the-art. |
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| **Mature Testbed** |
| **High Quality Testbed** | **Low Quality Testbed** |
| Testbed Requirements and Metrics: The ERC has established, clear requirements for the testbeds derived from the systems goals of the ERC and a set of performance metrics has been implemented and refined. | Testbed Requirements and Metrics: The ERC does not have established, clear requirements for the testbeds as derived from the systems goals of the ERC and a set of performance metrics has not been appropriately implemented. |
| Technology Integration: Testbeds are utilized to probe the research thrusts by testing the enabling technology, including devices and subsystem components, and integrating functionalities in a system-like environment. | Technology Integration: Testbeds are not utilized to probe the research thrusts by testing the enabling technology, including devices and subsystem components, nor integrating functionalities in a system-like environment. |
| Function in Research: The testbed serves as a versatile experimentation site, through which the performance of novel technologies are measured and/or compared with competing technologies and results are fed back into the research thrusts to stimulate improvements or generate new research directions. | Function in Research: The testbeds are not serving as a versatile experimentation site, through which the performance of component technologies are measured and/or compared with competing technologies. Testbed results are not fed back into the research thrusts to stimulate improvement s or generate new research directions. |
| Technology Translation: Testbed results are improving confidence in the technology’s performance and reproducibility. They highlight relevant applications and help accelerate technology translation opportunities.Research projects nearing translation to industry are refined and consider the specific market requirements (such as performance, manufacturability or cost). | Technology Translation: Testbed results are not improving confidence in the technology’s performance or reproducibility. Relevant applications or potential technology translations are not being pursued.Research project nearing translation to industry, are not ensuring that the design addresses specific market requirements (such as performance, manufacturability or cost). |
| Guidance: Testbeds are reviewed on a yearly basis by the ERC team with input from the IAB, SAB, and other appropriate user inputs, such as clinicians or local government users. Those inputs are used to optimize the testbeds functionality. | Guidance: Testbeds are not reviewed on a yearly basis by the ERC team with input from the IAB, SAB, and other appropriate user inputs, such as clinicians or local government users. Those inputs are not exploited to optimize the testbeds functionality. |
| Role in Education: Testbeds are providing students with hands-on experience in “building” technology that results in conference presentations and publications in refereed journals. Hands-on experience includes integrating devices and components, testing system-level performance, and envisioning market application requirements. | Role in Education: Testbeds are not providing students with experience in “building” technology, integrating devices or components, testing system-level performance, or understanding market application requirements. Very few opportunities for students to present at conferences or publish in refereed journals are coming out of the testbed research. |
| Assessment: Through the optimization of objective, stage-appropriate metrics, successful technologies are being identified and pursued; the testbeds are a critical tool for comparing and validating the research approach(es). The testbeds is clearly being used to push the technology state-of-the-art. | Assessment: The testbeds are not utilized for comparing the research approach(es), nor validating that successful technologies are being identified and pursued. Testbed lags the state-of-the-art. |