

9. EVALUATION AND IMPLEMENTATION METHODOLOGY

Goals are only wishes unless you have a plan.

—Melinda Gates, Co-founder, Bill & Melinda Gates Foundation

As noted above, this report has the overarching goal of providing a roadmap that can be used by policy makers to expand the State's robotics innovation economy. Of course, fostering growth implies prior knowledge as to the status of the cluster. This information allows cluster performance to be gauged and compared to previous levels, so that policy measures can be adjusted accordingly. Thus, any cluster development strategy must include a discussion of the following:

- **Evaluation Methodology:** What is the state of the Massachusetts robotics cluster currently and ongoing?
- **Implementation Methodology:** What course of action should the State undertake to expand the Massachusetts robotics cluster?

***Additional Insight:** Some issues related to public sector initiatives designed to drive Massachusetts robotics innovation are beyond the scope of this report. Examples include business, immigration, and tax policy that are the purview of the U.S. national government or international standards for robotics technologies and supporting infrastructure. K-12 STEM educational initiatives, while clearly important and under state control at some level, are not limited to robotics innovation, and are addressed in other studies, as are issues such as infrastructure investment.*

9.1. EVALUATION METHODOLOGY

Any implementation methodology intended to expand the State's robotics innovation economy must begin with an overall strategic assessment of the cluster. This report provides a snapshot of the Massachusetts robotics cluster in its current state, as well as a review of the cluster's history and the expected performance of the various robotics sectors in which cluster companies are competing. But going forward, the assessment process must be continuous, and not dependent on the infrequent issuance of reports of variable coverage, quality, and depth. To do so requires that the following initial steps be taken:

Going forward, the cluster assessment process must be continuous.

9.1.1. Develop a Commercial Class Database

Monitoring and analysis of the cluster's performance requires the development and maintenance of a commercial class database under the stewardship of a state-appointed entity.

9.1.2. Formally Define Cluster Members

To eliminate ambiguity, reduce subjectivity, and increase the accuracy of future assessments, cluster membership must be defined as formally as possible. As noted earlier in this study, cluster membership should be limited to those entities that meet the following requirements:

- **Headquarters:** Commercial cluster members should be headquartered in Massachusetts, or have an office in the State that is a major subsidiary or regional division office.
- **Primary Robotics Cluster:** The focus of this report is the primary robotics cluster which consists of over 97% of all robotics companies in the State (see Appendix H). Formally defined, the primary robotics cluster consists of the concentration of localized, mutually supportive businesses found within 50-mile radius of Boston and Cape Cod. The robotics companies outside this area lack the critical mass and concentration to form another regional robotics cluster.
- **Revenue or Support:** Commercial cluster companies must derive approximately 35% or more of their revenue from robotics products, technologies, or services, or a “robotics” division or subsidiary within a larger firm must do the same. Exceptions can be made for startups without revenue, as well as larger firms evaluating robotics opportunities or supporting the cluster in other ways.
- **Universities and Labs:** Massachusetts-based private and public university research laboratories; national laboratories and testing centers; or private, non-profit laboratories with currently active robotics research programs or initiatives are cluster members.

9.1.3. Utilize a Modernized Taxonomic Framework

Cluster companies should be classified based on a sector-oriented framework that provides information pertaining to the industries they serve, as well as the ultimate source of revenue or research funding (see Figure 1). This scheme provides for multilevel company descriptors that can be used to better assess the state of the cluster and provide for deeper, more meaningful analysis. It also better accords with the NAICS standardized taxonomy for industries, along with similar standards used throughout the world.

Cluster companies should be classified based on a sector-oriented framework.

9.1.4. Standardize Company Descriptors

To reduce ambiguity and facilitate analysis, cluster member companies should be classified according to a schema similar to that given in Appendix E, or a variation of the same. At a minimum, each company should be categorized as follows:

- 2 Sectors
- 2 Industries
- 3 Technologies/Products/Services

9.1.5. Simplify, Limit, and Standardize Cluster Indicators

Both cluster assessment (and expansion) strategies are dependent on formal descriptions and measurement of specific performance indicators. Unfortunately, opinions vary greatly as to which factors are most impactful for the creation and ongoing development of innovation clusters, and those that are optimal for gauging growth. Moreover, many competing cluster theories and innovation frameworks have emerged over time, each bringing to the discussion their own characterizations as to what constitutes success, as well as performance factors and other indices used to measure and achieve it (Davis et. al., 2006). Often, cluster indicators are only weakly predictive of economic performance, and their complexity can make them ill-suited as the basis for informed decision making.

Often cluster performance indicators are too numerous, complex, statistically unmeasurable, and only weakly predictive of economic performance.

The proliferation of disparate, often competing, cluster performance indices can make the task of describing, measuring, and optimizing cluster performance challenging. With each index, an additional level of complexity, and often uncertainty, is added to the process. This, in turn, extends or even postpones the cluster assessment process, both of which come at a cost. It also can limit the frequency by which cluster assessments are made, an important consideration in a rapidly expanding, dynamic technology sector such as robotics.

Overly complex assessment metrics reduce the frequency and increase the cost of cluster analysis.

For this study, ABI Research recommends a pragmatic, and ultimately more efficient, “less is more” approach for employing cluster performance indicators. Cluster innovation policy is enhanced when performance indices and assessment processes are:

- **Understandable:** It should be possible to define cluster performance indicators clearly, easily, and without ambiguity. They should be readily understandable by policy makers and others. In the same spirit, they should also be as limited in number as reasonably possible.
- **Measurable:** Cluster performance indicators should be statistically measurable, and easily so.
- **Meaningful:** Cluster performance indicators should be open to meaningful interpretation, and speak to business development and market growth.
- **Repeatable:** Cluster performance analysis should be a consistent, easily repeatable, and, perhaps, a largely mechanical process.
- **Comparable:** It should be possible to easily and quickly compare performance metrics across similar technology clusters worldwide.
- **Regular:** The process of gauging cluster performance should be undertaken regularly.

In accordance with the principals listed above, ABI Research believes that performance indicators for cluster assessment and the development of cluster expansion strategies should be limited to the following (Figure 30, below):

- **Companies:** The number of startups, small established firms, and large established firms operating within the cluster (descriptions given below)
- **Employees:** The number of total employees employed in Massachusetts robotics cluster companies or the robotics divisions of cluster companies
- **Revenues:** The yearly total revenue attributable to Massachusetts robotics cluster companies, or the revenue contribution of robotics divisions of cluster companies
- **Investment/Awards:** The amount of private investment and public sector funding attracted by Massachusetts robotics cluster companies, or the robotics divisions of cluster companies

Figure 30: Recommended Cluster Performance Indicators

(Source: ABI Research)



9.2. THE IMPLEMENTATION METHODOLOGY

The purpose of this report is to provide a roadmap that can be used by policy makers to enlarge the State's robotics innovation economy. "Roadmap" implies fixed goals, and often the inclusion of a timeline. The launch, attract, retain, and grow measures outlined in the Guidance and Recommendations section above are not tied to, nor do they adhere to, a strict timeline. There is no "5-year plan." There are objectives, but like the robotics sector itself, they are not fixed, and are sure to change according to time and circumstance.

The implementation methodology that is advocated is, in effect, an iterative, agile, self-correcting process designed both to continually monitor the cluster's performance and guide policy decisions. Frequent, detailed, yet simplified assessment is the key. This approach is more efficient, effective, and less costly than the development of staged roadmaps, and can be used to augment further studies if necessary. The process consists of six phases as given in Figure 31, and described in greater detail below.

Frequent, detailed, yet simplified cluster assessment is the key.

Figure 31: The Implementation Methodology

(Source: ABI Research)



9.2.1. Phase 1: Develop the Tools

The implementation methodology begins with the development of the tools to measure cluster performance—to make measurable what is currently unmeasurable, and to do so in a manner that is straightforward and consistent. The first, immediate, and critical step, therefore, is to execute the tasks given in the evaluation methodology described earlier.

9.2.2. Phase 2: Implement Recommendations

The second phase of the implementation methodology calls for carrying out the measures given in the Guidance and Recommendations section. It is assumed that some of the recommendations will be acted upon, and others not. Even if certain measures are agreed to, such as developing a STEM-E workforce, expanding internship programs, or professionalizing the branding/marketing of the cluster, they will take a significant amount of time to implement, and their results an even longer period to manifest. For these reasons and more, the guidelines and recommendations cannot be directly linked to explicit, fixed timelines.

The cluster development recommendations have been ranked (Table 15 and Appendix F). High-priority rankings connote both greater urgency and a greater anticipated impact. It should be noted that high-priority measures are largely designed to increase overall entrepreneurial activity, as well as aid young startups by removing barriers to innovation and commercialization. They also call for direct support, when necessary, to those companies in strategic markets with a strong potential for growth but that are too small to attract investor interest, or for sectors that map to the Commonwealth’s economic or historical strengths. Examples of the latter include the manufacturing, healthcare, and maritime sectors.

Guidelines and recommendations cannot be directly linked to explicit, fixed timelines, but they can be prioritized.

High-priority recommendations are designed to increase overall entrepreneurial activity, as well as aid young startups.

Table 15: Prioritized Recommendations to Accelerate Cluster Development and Increase Impact	
Recommendation	Priority
Launch Strategies	
Develop a STEM-E Workforce	3
Monitor Accelerator and Incubator Activity	3
Offer Low-cost Loans	2
Procure Pre-commercial Technologies	1
Attraction Strategies	
Professionally Brand/Market the Cluster	3
Employ Incentives	2
Retention Strategies	
Expand Internship Programs	3
Launch Co-op Program	3
Growth Strategies	
Support Testing Centers	3
Increase Local Demand	3
Increase Cluster Cooperation	2
Support Strategic or Nascent Markets	3
Leverage Existing Experience and Expertise	2

(Source: ABI Research)

9.2.3. Phase 3: Measure and Assess Performance

Regular, consistent assessment is key. It is recommended that cluster assessment based on the key performance indicators take place quarterly. If significant trends are uncovered (see Gauge Effectiveness, below), more rigorous analyses using additional performance metrics can then take place.

9.2.4. Phase 4: Gauge Effectiveness

Following the assessment phase, the effectiveness of policy-driven measures, as well as the impact of general business, technology, and investment trends, can be determined:

- Gauging Effectiveness of Launch Strategies:** The key metric of success for launch strategies is the number of new Massachusetts robotics cluster companies established over a fixed period of time. Investment, especially from private sector sources, is a secondary measure, as well as the quantity of firms launched over the course of 5 or even 10 years.
- Gauging Effectiveness of Attraction Strategies:** Indicators for success would be the number of companies or subsidiary offices established in the State over a fixed period of time. Other indicators include the number of employees working at the sites and the amount of revenue generated by them.
- Gauging Effectiveness of Retention Strategies:** Retention rates for graduates of both the public and private universities and colleges of Massachusetts can be determined, but they cannot be linked directly to robotics cluster growth. Internships are only loosely tied to increased retention rates, especially for graduates of private universities, and breaking out robotics

Company creation is the primary metric of success for launch strategies.

programs from other internships is a complex and time-consuming undertaking, thereby decreasing the chance that cluster assessments will be performed regularly and in a consistent manner. If the State were to fund robotics co-op programs, which are more strongly tied to graduate retention rates even for private school graduates and can be linked to specific robotics firms, then an additional retention performance metric can be devised.

- **Gauging Effectiveness of Growth Strategies:** The success of cluster growth strategies can be roughly determined by the growth in the number of employees at both small and large established robotics companies, as well as the revenue they generate.

9.2.5. Phase 5: Report and Evaluation

Concise cluster performance assessment reports are made available to policy makers, and possibly others, on a regular basis, highlighting pertinent indices and trends. In light of this information, existing cluster acceleration measures are evaluated and adjusted as necessary. New recommendations can also be put forth.

Cluster assessment reports are made available to policy makers on a regular basis.

9.2.6. Phase 6: Iterate the Process

The final stage of the overall implementation methodology is to iterate through all the stages beginning with Phase 2.