Metro Denver WIRED Region

Strategic Findings: Best Practices Analysis

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for the Metro Denver WIRED Region

Introduction: Developing Innovation-Based Economies

Regions across the world are competing today to develop the critical elements that drive innovation and economic development. Innovations like internet communications, global shipping capabilities, and factory automation have been just a few of the many changing dynamics in the global economy. These advances have affected the economics of large and small companies, and in turn, have impacted the communities in which the companies are located. Innovations have also put the U.S. economy on the defensive, as labor-intensive jobs have been replaced by technology or off-shored.

Regions must now accelerate their drive toward innovation in response to these new global dynamics. This means finding ways to incorporate knowledge and innovative practices into the economic value chain of local industries and to assist workers in upgrading their skills and finding high wage knowledge jobs. When innovation is achieved, the outcome can improve jobs, increase wealth, and diversify the target economy.

New Economy Strategies views innovation-based economies through a wide variety of activities that converge in geographies and incite growth in regional firms. Corporate activities are a large part of these activities and are essential to innovation. Other activities stimulate the innovation-based economy outside traditional corporate structures such as research universities, government facilities, and knowledge-sharing networks. The lens for economic developers must now focus on the positioning and enhancement of assets that drive innovation for both the recruitment and expansion of knowledge-dependent companies.

Regional Case Studies

Metro Denver is striving to compete globally in the following core technology-based industry clusters:

- Information Technology – Software
- Energy (Resource Extraction & Renewable Energy Industries)
- Aerospace
- Biosciences

These clusters are highly productive, have strong concentrations of knowledge workers, and are further complemented by strong regional assets including government labs, University labs, and military installations. The imperative to remain competitive in these industry clusters requires the region to seek out strategies that preserve current advantages while identifying and creating new opportunities.

In collaboration with Metro Denver's ongoing efforts, New Economy Strategies has identified Best Practices in other regional economies that apply to each of the four targeted industry clusters. The goal of this Best Practices Analysis is to inform and assist Metro Denver in improving its competitive position in each of the listed industry clusters. By viewing best practices of other regions, new concepts and ideas can be applied.

The following regions were selected in consultation with Metro Denver WIRED staff:

- **Information Technology-Software – India** was selected as a global leader in software and business process outsourcing. Few economies in the world are not influenced by India's role in the information technology economy. **Austin** was selected

due to its diverse mix of information technology activities including electronics design and manufacturing, digital media, and wireless technology.

- **Energy** – The State of **California** and the **Houston** metropolitan area were selected as reflections of the new and old energy economies. California is the center of a major portion of the alternative and renewable energy movement in the country. Houston has the full range of energy activities including fossil fuels/resource extraction industries and has early momentum in several alternative energy industries.

- **Aerospace – Los Angeles** was selected because it has traditionally been the hub for Aerospace industrial design and has both space and air force related activities much like Denver.

- **Biosciences** – the **Minneapolis-St. Paul** metropolitan area was selected due to its strong levels of biomedical research and medical device manufacturing.

These six regions were examined by NES for best practices within its identified target industry. The following factors guided our analysis:

- Cluster strengths
- Capacity of a region to innovate
- Programs, practices, and policies that embrace innovation
- Organizations that facilitate the wider exchange of ideas
- Availability of financial capital that supports new company growth
- Educated and skilled workforce
- Capabilities in product distribution and logistics

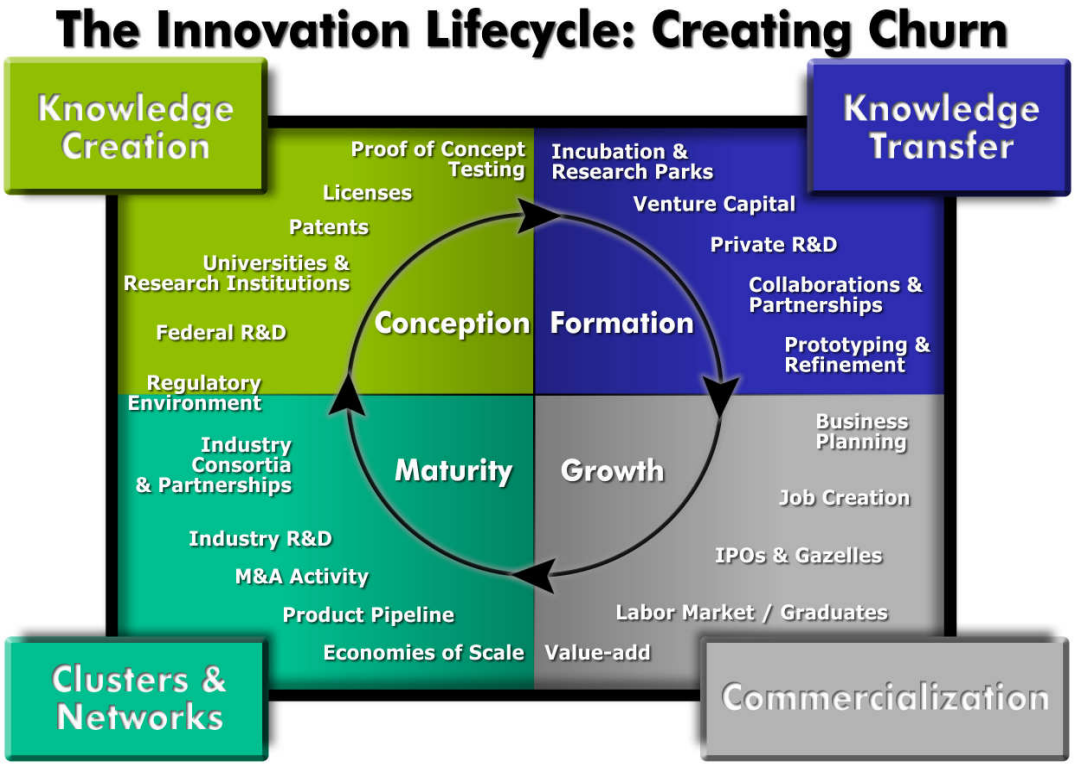
Best Practices Analysis: The Innovation Lifecycle

Global best practices are identified, evaluated, and prioritized by New Economy Strategies through the lens of the "Innovation Lifecycle."

Innovation has become a top priority for nations to stimulate economic development and strengthen their competitiveness. Over the past ten years, a new global innovation system has evolved in the U.S., with support from government and industry for basic research in universities, nurtured by rapid growth in venture capital and implemented by industrial firms through strong investments in R&D, capital equipment, and information technology. This highly complex system of innovation is also based on closer collaborations and increasing alliances among industry, universities and government labs.

More than simply utilizing technology, innovation is the ability to take new ideas and translate them into commercial outcomes by using new processes, products or services in a way that is better and faster than the competition. The ability to do this requires a social, inclusive process among individuals, institutions, and organizations that results in new business models, new forms of engagement, and ultimately, new companies. Today, new firms create a greater portion of job growth than do established larger companies. In the New Economy, innovation and productivity are the cornerstone of competitiveness, and ultimately prosperity.

To better understand the process of innovation, New Economy Strategies has developed the "Innovation Lifecycle." This model is the lens through which we identify best practices, evaluate them, and ultimately insert them into regional economies that suffer innovation gaps. The Innovation Lifecycle is like a relay race – a seamless, circular pattern with four stages: Knowledge Creation, Knowledge Transfer, Commercialization, and Clusters & Networks.



In each stage, the baton must be passed smoothly and skillfully to ensure the successful completion of the cycle and the beginning of another. Funding, infrastructure, a clear understanding of the knowledge transfer process and risk, and appropriate business skills all represent strategic batons and potential hurdles in the race to innovate and commercialize.

The goal is a perpetual, self-generating relay that builds momentum with every new lap. A fumbled baton can bring the lifecycle to a halt, threatening the success of both current and future endeavors. A relay that improves in pace and completes over and over again creates "churn," which generates new jobs, new companies, and new industries.

A region does not need to excel in all the elements – it only needs access to all the elements. Regions with well developed commercialization infrastructures, for example, can leverage their strengths by importing intellectual property from regions strong in research. Conversely, regions with research strengths can form linkages with regions with development and commercialization strengths in order to extract the value from their outputs.

Best Practices Applied to the Metro Denver WIRED region

The following analysis summarizes important activities presented in the case studies that drive and support innovation-based economies. The function and capacity of each activity must be understood and leveraged for best results. New Economy Strategies selected the following important baseline areas for the continued development of Metro Denver's innovation-based economy. Metro Denver is rich in assets for technology-based economic development in each quadrant of the Innovation Lifecycle that yield strong opportunities for economic growth. It is critical that the following functions come together to work as a system that will grant Metro Denver the best opportunity for growth in their target industries.

- Infrastructure for Innovation
- Knowledge Transfer
- Commercialization
- Workforce Development
- Public-Private Partnerships & Initiatives

Infrastructure for Innovation

Innovation-based economies must have the ability to generate new knowledge or intellectual property to initiate the first step of knowledge creation. Knowledge creation occurs frequently in the research and product development of firms. Other potential sources of knowledge creation are government sponsored research and contract research which may occur at government facilities, universities, or private companies. Knowledge creation is dependent on a region's critical infrastructure that supports this activity in whatever manner it is uniquely housed and funded. Infrastructure for innovation involves the examination of the sources of basic and applied research that would naturally be located at a research institution as well as mechanisms created for specific industry applications.

Case for Metro Denver:

Metro Denver's infrastructure for innovation is rich and diverse. The region has the infrastructure for significant knowledge creation to occur including university departments and labs, federal government labs, contract research organizations, and nonprofit research institutions.

Metro Denver has strong assets in its research-driven federal government laboratories. The Center for Disease Control and Prevention has a lab located in Fort Collins. National Oceanic and Atmospheric Administration's Environmental Technologies lab is located in Boulder. The National Renewable Energy Laboratory has established Metro Denver's presence in innovation of alternative and renewable energy technologies in the U.S.

The University of Colorado, Colorado State University, and the University of Denver all receive research contracts from NASA with the University of Colorado conducting significant levels of space-related research. Raytheon, Lockheed Martin, and Ball Aerospace receive funding for the generation of new concepts from the federal government. Contract research is being performed for a number of industry applications at regional firms like TDA Research, Eltron Research, Kestrel Labs and Nanomaterials Research Corporation. The National Science Foundation funds projects in advanced computing at both Colorado State University and the University of Colorado, which bodes well for regional advancement of information technology.

Metro Denver Region
Sample Infrastructure for Innovation

Federal Laboratory
- National Renewable Energy Laboratory
- NOAA's Environmental Technologies Lab
- Center for Disease Control & Prevention Lab in Fort Collins

Universities
- Colorado State University
- University of Colorado
- University of Denver
- Colorado School of Mines
- University of Colorado Health Sciences Center at Fitzsimmons

Contract Research
- Eltron Research
- Kestrel Labs
- Nanomaterials Research Corp.
- TDA Research

Private Research Institutions
- National Jewish Medical Research Center
- Space Science Institute

Biomedical research in Metro Denver is vast at the University of Colorado Health Sciences Center, Colorado State University, the National Jewish Medical Research Center and several other facilities. Additionally, the Metro Denver region was recently named the 5th most attractive location for life science research and development by Site Selection magazine.

Metro Denver must continue to ask two questions about its infrastructure for innovation:

1. Are research applications being transferred and then accelerated into forming new companies and then selling products? (See the following knowledge transfer and commercialization discussions)
2. How is industry connecting with knowledge creation activities?

The ongoing challenge for the region will be to maximize opportunities where industry expertise can be linked with the profound amounts of university and government research. The best practices review points to several paths forward. For instance, Houston's assets in the categories of government facilities and universities are not to the robust level of Metro Denver. However, industry in Houston is committed to advancing renewable and alternative energy technologies. Houston has the advantage where early-stage technologies can "spin-in" to regional firms like Shell and Chevron, whereas Denver's focus must be on spinning out technologies from the laboratories. Fostering national industry partners working with local government and university researchers will be critical in fostering success of Metro Denver WIRED's renewable energy sector.

In continuing to identify and support ways to connect research with industry, regional collaborative models should be identified and highlighted. The best starting point is likely the Aerospace cluster where large firms often work hand-in-hand with researchers. Metro Denver has some of the firms that have the know-how to collaborate on research projects. (Ball Aerospace, Raytheon, Lockheed Martin). Metro Denver could invite these corporate leaders to showcase their technology development model to smaller entrepreneurial companies in all technologies sectors so others could benefit from innovation infrastructure in the Metro Denver WIRED region.

A look toward NASA's Jet Propulsion Laboratory in Los Angeles showcases how a federal laboratory can work intensively with companies like Northrop Grumman to develop technologies and applications that often become new contracts for the government. Further information on the Jet Propulsion Laboratory and its activities is available at www.jpl.nasa.gov.

Knowledge Transfer

The intellectual property developed from the regional infrastructure for innovation assumes the form of patents and concepts. Innovation is advanced when these patents and concepts are licensed to start-ups and existing firms. A key challenge in this "technology transfer" from researchers to developers is compelling researchers and developers to cooperatively identify valuable technologies and foster their development. Many researchers are dedicated to advancing science but have little expertise or interest in commercial outcomes of their research.

Case for Metro Denver:
Metro Denver's critical needs in knowledge transfer are at its research universities and federal government research laboratories. The ability to transfer technologies out of these institutions will accelerate innovation in Denver's high-tech industries. Finding best practices in this field is challenging due to the difficulty in the practice of technology transfer itself and the challenges in measuring when the transfer occurs. Few institutions can make the claim that they really do it well. Success comes from employing tactics that accelerate the transfer of knowledge through supporting structures and incentives. Also, the expertise of the individuals involved continues to be proven as an equally critical resource.

With this in mind, several examples from the case studies point to leadership in technology transfer. The University of Minnesota has built strong supporting mechanisms aimed at accelerating technology transfer including Technology Transfer Liaisons whose job is to work intensively with faculty on the commercial applications of their research. What makes UM's approach unique is that the university has attempted to build a system where technology transfer is emphasized and supported at multiple levels. The University of Colorado System's Technology Transfer Office does have in place a Proof of Concept Grant Program similar to UM's Innovation Grants. The CU system could possibly benefit from a site visit and meetings with UM's representatives for the purposes of learning how to build a systematic support system and institutional culture that foster more frequent technology transfer. Further information on the University of Minnesota Office for Technology Commercialization is available at www.research.umn.edu/techcomm/.

Similar principles could be applied to Metro Denver's government research laboratories (DOE's National Renewable Energy Laboratory, NOAA's Environmental Technology Lab, and CDC's lab in Fort Collins). Advancing science and research are the primary motives of federal government researchers. Lawrence Berkeley National Laboratories in Berkeley, California is known for its unique incentives and strength in knowledge transfer where other national laboratories have struggled. Further information on the Lawrence Berkeley National Laboratory's tech transfer operations is available at www.lbl.gov/Tech-Transfer/.

Commercialization

Often technology transfer and commercialization are merged into one logical progression. However, technology must be transferred before it can be commercialized. Commercialization is the next step where the concepts and patents become marketable products through additional research and product refinement. The challenge at this step is narrowing down the applications for a new technology to the ones with the best opportunity for commercial success. Intensive incubation, mentoring, and often collaboration of industry, entrepreneurs, scientists, or business experts are required at this step. For small companies, access to various forms of early-stage investment capital is needed. Furthermore, as commercialization scales upward, a need for additional engineers and technicians emerges, as well as marketers and operations strategists.

Case for Metro Denver:
Metro Denver has several resources for the commercialization of technologies. The Fitzsimons BioBusiness Incubator is a newly established incubator specifically designed to serve the Fitzsimons Bioscience Research Campus and new bioscience companies from concept to commercialization. CTEK Venture Centers focus early-stage companies on access to capital and business development. There is also an incubator in Fort Collins (Ft. Collins Virtual Incubator) covering regional commercialization needs. Furthermore, Metro Denver appears to have active investors for all stages of business development and entrepreneurs and business experts to provide advice and mentoring for new technology ventures.

With all of these resources touted in the region, it is crucial that the resources are appropriately aligned and made accessible so they can be utilized. Young companies do not need additional hurdles to overcome to access commercialization assistance. Overbearing equity positions required by incubators in order to provide their assistance to companies is one concern that can diminish a regional commercialization assistance portfolio. This can occasionally happen in regions with the build-up of several incubation facilities. Also, just because there are resources for commercialization does not necessarily mean knowledge transfer gaps are being bridged. Considerations like these should cause Metro Denver to further examine its regional commercialization assets more thoroughly. A number of outcomes could be learned from such a process that could assist in understanding the linkages and potential gaps in technology transfer operations and the further commercialization of technologies. Topics for the study to bridge include:

- Where is the intellectual property coming from that is the focus of the commercialization activities in the incubators? (universities, federal labs, entrepreneurs in general terms)

- How are the incubators accessed by the community?
- How frequently/effectively are all forms of capital being utilized? (VC, angel capital, SBA loans, SBIR and STTR grants, and traditional bank lending)
- Are the incubators operating as best-in-class relative to the nation? (governance structure, incentives/disincentives for tenant selection, vendor support)

Universities often provide the breadth of resources to address critical aspects for commercialization. However, not all universities create the appropriate mechanisms to support the activity. Metro Denver's regional universities will need to adapt a stronger focus on commercialization for the growth of technology-based industries. The University of Texas-Austin's IC2 Institute is a best practice where commercialization is prioritized and the process is accelerated by serving as a convener for experts in science, business, and entrepreneurship to connect on new technologies. Further information on the IC2 Institute at the University of Texas-Austin is available at www.ic2.org. A strong example of this activity in the region is Colorado State University's Supercluster concept. Superclusters are designed to trigger a multidisciplinary response to global challenges among CSU scientists, researchers, and business experts.

Workforce Development

The quality of a regional workforce is important in developing innovation-based economies. Emerging industries will naturally require new knowledge and skills because of the new technologies and business processes which they are founded upon. Innovation-based economies thus require a dynamic regional workforce composition that places high demands for a strong workforce development system. To this end, regional workforce development requires both a strong educational value chain as well as skills-based strategies.

Case for Metro Denver:

An ongoing theme in the region has been that Metro Denver's industry demand for skilled workers will outpace the projected supply. The aerospace industry is especially affected as older workers retire. It is most rational to attack this situation from all possible angles to fill the requirement of the innovation-based economy. Best practices represented in the case studies demonstrate a range of workforce strategies at several education levels. The Metro Denver WIRED region should examine the following programs in consideration for local adoption:

1. Advanced science and engineering degree granting programs (www.lmu.edu/Page23586.aspx)
2. University-level technology management programs (www.cdtl.umn.edu)
3. Industry targeted business/technology management (www.bauer.uh.edu/gemi)
4. Specific skill development for industry targets (www.sematech.org/research/nwdi/index.htm)
5. Corporate recruitment programs (www.slb.com/content/about/university.asp)
6. Regional STEM initiatives (http://hunstem.uhd.edu)

The educational value chain starts with achievement in elementary and secondary education. Graduates of these institutions then attend degree-granting community college, technical college and university programs. This is often where local entrepreneurs and thought leaders on technology are developed and nurtured and graduate to contribute to a regional economy. Two year community and technical college programs are essential in providing multiple post secondary education pathways for students, and building a responsive education environment for entrepreneurs, who often desire to piece together needed skills in shorter timeframes. The case studies also reference four-year programs that cultivate students to lead technology businesses including the Global Energy Management Institute at the University of Houston (www.bauer.uh.edu/gemi) and the University of Minnesota Center for the Development of Technological Leadership (www.cdtl.umn.edu). These are both good examples of preparing workforce specifically for target industries for regional economic growth.

Investing and initiating program in earlier stages of education can provide the groundwork for expanded interest, participation, and overall abilities for regional science, engineering, and business management. Greater Houston's HUNSTEM initiative (Houston Urban Network for Science, Technology, Engineering, and Mathematics, (http://hunstem.uhd.edu)) is an education program to mobilize basic science and math competencies at several levels of student learning and integrating with schools and resources across this region.

The skill-based approach is the typical perception of workforce development or cultivating human skills to match the demands of local industry. Metro Denver has strong talent stock throughout the region but must find ways for greater mobilization for industry needs. For example, understanding of nanotechnology is now sought in the information technology industries in Austin, which has created the Nanoelectronic Workforce Development Initiative (NWDI) through a local industry and community college partnership (www.sematech.org/research/nwdi/index.htm). Loyola Marymount University engineers are strategically aligned with Northrop Grumman, the Los Angeles area's largest aerospace manufacturer (www.lmu.edu/Page23586.aspx). Metro Denver must continue to define its target industries and the requirements of the workforce of those industries. Regions must also have the capability of not just growing and mobilizing local talent, but recruiting critical talent needs, especially at high-skill level occupations in science and engineering. Not all corporations are getting their strategies right and their businesses are suffering from underperforming human resources. Schlumberger's approach is an example of a recruiting process from a globally recognized firm that could be replicated and expanded by economic and workforce developers in regional firms (www.slb.com/content/about/university.asp).

Public-Private Partnerships & Initiatives

Public-private partnerships can be instrumental in accelerating innovation-based economies. Successful partnerships can assist the effective leverage of funding sources from both public and private sources. They can serve as mechanisms to implement strategy and regional alignment around common goals, and also provide important regional connectivity and knowledge-sharing networks between important actors in the local economy. In summary, effective partnerships can be critical bridge builders in advancing a region's agenda for innovation.

Case for Metro Denver:

Metro Denver is the home of numerous forward-looking policies, partnerships, and initiatives that accomplish several purposes. The region must continue to ensure that its working partnerships are perpetuating the elements of the Innovation Lifecycle. Regional mechanisms that can sustain innovative practices are important in dealing with economic fluctuations. The key question for Metro Denver in advancing its agenda remains:

- Is the community converging and connecting on the opportunities to perpetuate innovation in its targeted industries and technologies?

Public-private mechanisms can assist in advancing the agenda for each of the important functions described in this analysis. Connecting industry with the infrastructure for innovation can be challenged when industry is not aware of newly developed technologies at universities or research labs. An effective partnership can keep them abreast of these activities in common geographies. By the same token, the public sector must be aware of the changing dynamics within industry. The Wireless Networking & Communications Group (WNCG) at University of Texas-Austin is a strong example of industry involvement in research and development. Further information available at WNCG is available at www.wncg.org. Austin is also progressive in workforce development for emerging industries with examples like the aforementioned NWDI program focusing on training the new wave of electronics designers to accelerate its strong information technology industries (www.sematech.org/research/nwdi/index.htm).

CTEK Venture Centers are one of the primary the business accelerators in Metro Denver that link entrepreneurs generally to technology transfer and commercialization elements of the innovation-based economy. Metro Denver must explore whether the program is fostering the

appropriate connectivity in its targeted industries, technologies, and key human capital. For example, the National Renewable Energy Laboratory in Golden, Colorado is strategically aligned with the Austin Technology Incubator as opposed to Metro Denver regional mechanisms.

Other initiatives could also be explored for opening up regional markets, strategically advancing technologies. A good example from the case studies is the Green Wave Initiative in California. This is an example of a capital formation strategy to work to develop the state targeted technology area of renewable and clean energy by merging large pools of public-backed funding with private investment. California realized that for state technologies to gain early advantages, the state's large marketplace for energy must be opened as much as possible. Further information on the Green Wave Initiative is available at www.treasurer.ca.gov/greenwave/index.asp.

A final key area of connecting an innovation-based agenda is regional branding, positioning, and alignment of common regional objectives that can be explored through a number of best practice approaches. The Medical Alley is a regional initiative aligning industry and public resources to map out a regional Biosciences vision in Minnesota (www.medicalalley.org). The Sacramento metropolitan area also has a current strategy underway which is aligning all emerging renewable energy activities into an umbrella strategy for regional economic development (www.valleyvision.org/partnership/index.html). Metro Denver must continue to refine and develop regional strategies that address the regional innovation needs through all its regional partnerships and initiatives.

Conclusions

Throughout our analysis we have identified key functions of innovation-based economies. Metro Denver should further study and integrate practices (from case studies or others) to strengthen and refine these functions.

Infrastructure for Innovation: Explore industry's role in knowledge creation

- Strengthen partnerships between industry with government and university researchers.
- Hold an information sharing symposium on technology development models of large and small companies from regional target clusters that can benefit from superior innovation infrastructure and processes.

Knowledge Transfer: Explore new structures and incentives to accelerate the transfer of knowledge out of the region's research institutions

- Participate in a site visit of a selected University that takes a systematic approach to technology transfer and commercialization.
- Explore various incentives to accelerate the transfer of technology from federal laboratories like the Lawrence Berkeley National Laboratory.

Commercialization: Analyze regional assets supporting commercialization

- Conduct a study to address some of the perceived gaps between technology transfer and commercialization including the assessment of incubators and business accelerators and the flow of various levels of capital.
- Participate in a site visit of a commercialization system at facilities like the IC2 Institute in Austin to learn about the strength of the institution's connectivity model for commercialization.

Workforce Development: Integrate multifaceted approach to training a workforce for an innovation-based economy

- Metro Denver must continue to define its target industries and the requirements of the workforce of those industries and implement the findings in the workforce development system.
- Examine programs to address all potential needs of the workforce system to support innovation; develop, retool, and implement programs addressing critical needs of the innovation-based economy.

Public-Private Partnerships & Initiatives: Analyze current industry partnerships and initiatives that are connecting the key elements of the innovation-based economy

- Study regional mechanisms connecting, branding, and aligning the region's agenda for innovation.
- Implement key strategies that connect Metro Denver's overall innovation agenda.

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Austin

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Los Angeles

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