



Akron's Polymer Cluster:

Pre-Vetting the Potential for a Cluster Initiative

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Crucial Context

This report assumes that readers are deeply familiar with the Elevate Greater Akron strategy, and somewhat familiar with the Brookings report “Rethinking Cluster Initiatives” including the associated case studies.

Specifically, readers must understand:

- They key findings about Akron’s current economic situation presented in Elevate Greater Akron, the “new fundamentals” concept, and the five strategies.
- How the polymer industry is already being recommended as an “organizing principle” for business retention and expansion work in the Elevate Greater Akron strategy.
- What is meant by a “cluster initiative”, as illustrated by the case studies in “Rethinking Cluster Initiatives”. In particular, readers must understand that a cluster initiative is not what most regions do (pick 5-8 clusters for promotion and marketing efforts). Rather, cluster initiatives are built around a clear understanding of the industry’s growth opportunities and the shared barriers that firms face in achieving that growth.

I. Purpose of this Report

The purpose of this report is to answer one overarching question: does Greater Akron's polymer cluster represent one of the best opportunities to propel the region's economy onto a new trajectory over the next decade? Resource constraints dictate that the region likely has just one or two chances to make a truly transformative investment in the near future, implying that local leaders must conduct an unbiased and rigorous evaluation of each potential alternative, and understand trade-offs among them, before making important strategic decisions. This briefing, whose primary audience is the Elevate Greater Akron Steering Committee, represents this initial evaluation of the polymer cluster.

This assessment begins from a skeptical standpoint with regards to cluster initiatives. Our belief is that cluster initiatives can be far more transformative than other approaches when the right ingredients exists and smart strategies in place, but also that far more cluster initiatives have failed or stagnated than succeeded, and cluster-agnostic approaches can be equally, if not more, impactful. (See sidebar at the end of this section.)

This means that the “burden of proof” rests on the polymer cluster: unless it can be demonstrably proven that the polymer cluster does represent one of the two most low-risk, high-reward strategic approaches to position Akron's economy on a new trajectory over the next decade, then local leaders should assume that other strategic alternatives are better suited for transformative investments. Therefore, the project was designed to vet whether the polymer cluster meets the basic “burden of proof” before any more time or money is spent designing major initiatives around it. It does this by attempting to answer a key set of sub-questions, including:

- Do existing firms in the polymer cluster have *meaningful shared needs* and are they *motivated to engage* together in (and drive) a robust cluster initiative?
- If so, what – if anything – can the region's economic development organizations (EDOs) do to address these shared needs to accelerate the development of the cluster?
- Would it *make strategic sense* to pursue these potential opportunities, given that successful cluster initiatives have proven to be very expensive and the region faces significant resource constraints?

This third point requires further elaboration – what makes “strategic sense” depends entirely on the goal. The Elevate Greater Akron strategic plan is focused on building “the new fundamentals” that will help build the Akron economy incrementally from within. It generally takes a skeptical view of risky “big bets”. Despite universal agreement that this is the right near-term approach, Akron's long-term goals go beyond incremental change. While the Elevate Greater Akron strategy establishes a crucial *foundation* for achieving transformative change, the tactics will likely not result in hugely transformative change (because they were created based on the assumption that resources would remain fixed in the near term). To achieve their long-term goals, Akron's leaders will at some point need to step beyond the bounds of the Elevate Greater Akron strategic plan and secure resources for a major, targeted investment in developing new skills, technological capacities, or other assets that will position Akron as a unique center for a growing, innovative industry and thereby make it a magnet for investment from outside the region. (See sidebar at end of this section.) What “makes

strategic sense” is therefore a question of which investment is most likely to achieve that outcome. It could be a polymer cluster initiative, but it could just as likely be (for example) a major mid-tech skills effort that could both strengthen existing firms and potentially attract new tech operations from increasingly expensive coastal areas.

Finally, it is important to be clear what this report is *not* intended to do. It is not calling into question the *importance* of the polymer cluster in Greater Akron and Northeast Ohio. It is undoubtedly important, not only in terms of jobs but also innovation, exports, and the supply chain activity it supports. It is for good reason that the industry has been the focus of recent assessments by the Ohio Polymer Strategy Council and Team NEO, that the University of Akron invested additional resources in

its Department of Polymer Science amidst university-wide program cuts, and that Akron economic development staff continue to focus on the industry.

Nor is it calling into question whether *any effort* should be directed towards the polymer cluster.

There are undoubtedly unrealized economic development opportunities in the cluster.

The question is whether the cluster should continue to be viewed simply as an organizing principle for economic development efforts designed to maintain and support existing firms in a generally mature industry; if the region should advocate for a major initiative at the Northeast Ohio or statewide level, in which local actors would proactively participate; and/or if Greater Akron should make a major (multi-million dollar) investment of its own in a cluster intervention.

Sidebar

Clusters and Transformative Outside Investment

It is almost certain that an economy like Akron's that has been "coasting" off of legacy strengths for decades will need transformative outside investment to revitalize it. But it is critical to distinguish between (a) the goal of becoming a magnet for outside investment and (b) the strategy of trying to attract outside investment as a way to build a cluster or industry. High-quality outside investment (i.e., innovative firms that are highly competitive and therefore pay their workers at all skill levels high wages) is attracted by highly functioning local "ecosystems". Therefore, somewhat counterintuitively, achieving the goal of attracting outside investment requires mostly avoiding investment attraction as a strategy and instead spending resources on building the capacity of local firms, workers, and institutions.

The best cluster initiatives in peer markets like Indianapolis, Milwaukee, St. Louis, and Syracuse (which are also "neither distressed nor dynamic") illustrate this principle. Their cluster-oriented economic development initiatives do not focus on attracting outside investment (i.e., branding, marketing, trade shows) as the core activity. They spend more time and money on boosting the competitiveness of existing firms by addressing local market failures related to R&D, capital availability, skills, infrastructure, and inter-firm networking. However, it is still the case that attracting outside investment is undeniably a key goal and celebrated outcome of their local efforts. For example, St. Louis recently attracted the 75-job R&D center of a major German seed company (its first U.S. location) with very few incentives, largely because of the work that it had done locally to create a vibrant innovation ecosystem in the agriculture technology industry.

It is also important to point out that transformative outside investment does not only mean attracting new firms to the region. It can include venture capital, specialized talent, mergers and acquisitions, new investments from the parent companies of existing local firms, and even state or federal government investment. For example, the Upstate South Carolina region just bolstered its own advanced materials cluster with a \$20M grant from the National Science Foundation that will allow Clemson to hire five new faculty members, support 12 new doctoral students, and invest in new equipment for materials research (including polymers).

II. The Basics: Defining, Prioritizing, Strategizing, and Designing Initiatives

How to Define Clusters

Not every industry is a cluster. This is true even of large industries. At the heart of the idea of clusters is interdependence: if it is a cluster, the firms within it are more competitive by virtue of their proximity to, and interaction with, the other firms within it. If firms are generally ambivalent about the presence of other firms in their industry, then it is not a cluster.

Making cluster-oriented investments in what is actually just a disconnected collection of firms that happen to be in the same industry is unlikely to be effective, or at least no more effective than an investment designed to benefit an industry-agnostic group of firms (i.e., all startups or all mid-sized firms). The first step in designing a cluster initiative, therefore, is to determine whether the industry in question truly is a cluster. The basic ingredients of a cluster are:

- **Scale:** the industry needs to contain multiple firms (related institutions like universities and research labs count).
- **Proximity:** those firms need to be physically close to each other; typically, within the same metro area.
- **Interdependence:** clusters are defined by the fact that firms within them depend on one another for a competitive advantage. Different clusters involve different types of interdependence. Firms in some clusters gain a competitive advantage from having easy access to local supply chains, whereas firms in other clusters primarily benefit from exchange of technology and know-how with other firms. Three forms of interdependence exist, and all three exist in the most robust clusters:
 - **Supply chains:** Firms benefit from being part of large and dense supply chains. The presence of many customers allows suppliers to specialize and become more productive, while the presence of many suppliers is efficient for customers. The interaction between suppliers and customers supports rapid learning and joint innovation.
 - **Skills:** Firms benefit from being in labor markets with an abundance of specific types of skills. Skill- or occupation-based connections between firms are often missed when analysts rely only on industry-level data. (For example, firms from a variety of industries and different supply chains could all be drawn to Northeast Ohio for its chemistry expertise.)
 - **Technology:** Firms cluster because they benefit from close enough to innovation that they can capture “knowledge spillovers”. Firms will cluster to be part of a learning process between other firms, universities, research institutes, government, and other institutions. Firms are especially prone to clustering in emerging, pre-commercialization industries in which knowledge is not yet codified. (This form of interdependency often overlaps with skills, but not necessarily – one institution or a few leading researchers can be enough to draw firms in, regardless of the broader regional skills base.)

One reason for the confusion around clusters is that there are few, if any, hard quantitative standards for these criteria. Is the required scale 10 firms, 100 firms, 1000 firms? Is the required proximity at the city, regional, or state level? At what point do interdependencies around supply chains or technology spillovers become a real, unique competitive advantage for firms?

In other words: the question of whether these criteria *exist* in a given industry can (mostly) be answered using data and interviews. But the question of whether a cluster has *enough* of these criteria to justify action is a strategic question that requires (a) having a clear idea of strategic trade-offs involved in choosing to invest in any cluster and (b) further understanding the characteristics of the cluster in question (beyond these “essential criteria”) that might make it worth prioritizing relative to other strategic alternatives.

How to Prioritize Clusters

Because the basic definition of a cluster is so broad, many metro areas can easily identify five or more. The process of prioritizing among clusters that meet the basic definition or deciding whether or not to invest in a cluster initiative at all, will therefore likely hinge on an additional set of criteria. These criteria are not strictly required to define an industry as a cluster, but are crucial determinants of how likely it is to benefit from a cluster initiative, how likely a it is to grow in the near- and long-term, and how much that growth will benefit the broader local economy. Clusters that don't meet these criteria may still be important enough to use as a basic organizing principle for BRE and workforce efforts, for example, but should not be targets for major cluster initiatives. These criteria are as follows:

Prioritization category 1: how likely firms are to benefit from a cluster initiative?

- **Clear problem:** In order to justify a cluster initiative, EDOs and firms must have a clear sense of what **opportunity** the industry has to evolve and grow, and what **problem** is preventing firms from realizing that opportunity currently.¹
- **Firms that are motivated to solve problems collaboratively:** Every successful cluster initiative relies on the willingness of firms, especially larger firms, to contribute their own time and resources towards addressing these problems. They must believe that their problems stem from, or could be addressed by changes to, the regional “industrial commons” (as opposed to believing that their problems are entirely related to internal resources and strategy). Demonstrated motivation on the part of firms is an absolutely critical criteria. A committed “champion” from a leading multinational firm is crucial. Regional efforts can help strengthen relationships between firms and help sharpen their shared narrative, but they cannot create these from scratch and expect them to endure.

¹ Note that page 10 contains examples of where cluster initiatives tend to intervene; looking at these will give a clearer sense of what opportunities/problems clusters might face that are conducive to cluster-scale intervention.

Sidebar

Business engagement/champion: the pharmaceutical industry in Indianapolis is threatened by declining patent pipeline, which in part stems from declining federal R&D in basic research. Companies like Lilly (primarily) recognize that they cannot solve this problem simply by changing their internal strategy; their ability to innovate is reliant on the region's ability to innovate. So, in 2012 the Lilly Endowment put \$80 million into forming the \$150 million Indiana Biosciences Research Institute, which is aimed at attracting top researchers to do collaborative, industry-relevant research on metabolic diseases. Similarly, numerous multinationals in the auto industry fund collaborative research at CU-ICAR in Upstate, and Monsanto is one of the largest funders of agriculture technology cluster efforts in St. Louis.

- **Concentration of firms with high-end functions:** What matters more than the quantity of firms in the cluster or that are motivated to engage in joint problem-solving is the quality of those firms. Cluster initiatives almost all focus on the innovative frontier of an industry, where there are abundant uncertainties and market failures that prevent firms from seizing opportunities on their own. (A cluster initiative designed simply to help shore up a mature industry might theoretically be justifiable if that industry represents a huge number of jobs, but ultimately regions can do more to support the growth/development of industries than they can do to prevent the decline of a mature industry.) Therefore, cluster initiatives require the involvement of firms that are engaged in innovation – which means firms that are headquarters establishments, R&D operations, or manufacturers that have the capacity to engage in process innovation.

Prioritization category 2: how likely the cluster is to grow?

- **Stage of development:** regardless of local firm-level strengths, it is crucial to understand the global growth potential of an industry before investing in a cluster initiative. (Having the best typewriter manufacturers in the country is not a good justification if the typewriter industry globally is declining.) There are four basic categories used to describe the stage of development of an industry: *potential, emerging, established, or declining*. These categories do not have hard-and-fast definitions, but generally speaking, emerging or established clusters are better priorities. (It is very risky or impossible to try to build up a “potential” cluster – often a euphemism for a practically nonexistent cluster – or rescue a “declining” cluster.)
- **Specialization:** Measures of specialization (typically in the form of location quotients) are meaningful when combined with information on stage of development. If an industry is emerging or established, and a region has a significantly higher than average concentration of that industry already, then a region is likely going to inordinately benefit from expected growth in the industry. (Because the region’s business environment has already proven to be unique and attractive for firms.) All else equal, specialization indicates that a region has a chance to become a truly unique location for a particular industry – somewhere that firms need to be, regardless of the cost.

Prioritization category 3: how likely the cluster’s growth is to benefit the regional economy?

- **Likelihood of broad spillovers:** One rationale for investing in a cluster initiative is that the investments will not only directly benefit the innovative core of the cluster, but also indirectly benefit other firms in the region. One important way to assess whether a wide variety of firms might benefit from a cluster initiative is by examining whether the firms in the innovative core are working on technologies that are *complex and related*. “Complex” means that the technologies are so new that knowledge about them is tacit. Firms cannot transfer this tacit knowledge to other markets and exploit it, so it is likely to remain in circulation locally. “Related” means that it stems from existing technological strengths in an area. Innovations in “related” technologies can trickle down to non-innovative local firms, because even if they don’t invest much in R&D currently, they likely understand the fundamental science behind the innovations. For example, cutting-edge research on adhesives (complex, related) could trickle down to

less-innovative local firms in the paint/coatings industry; whereas biotech research (complex, unrelated) would only benefit the companies directly involved.

- **Quality jobs:** Ultimately the point of investing in a cluster is to create or retain good jobs for people. Therefore, a cluster whose growth is likely to result in not only job growth, but growth in the particular types of jobs that the region needs, is especially worth prioritizing. Typically, this means middle-wage jobs that are unlikely to be automated and have relatively low barriers to entry.

Prioritization category 4: how do existing cluster initiatives/assets compare to peers?

- **Quality of existing cluster initiatives:** Especially in a resource-constrained region, it is worth prioritizing clusters that can “piggyback” on existing state and regional initiatives (assuming that the cluster *also* meets other criteria). If these existing initiatives are superior to those in other regions, it provides a first-mover advantage that can keep a smaller region in the running even as larger, better-resourced regions turn their attention to the cluster.

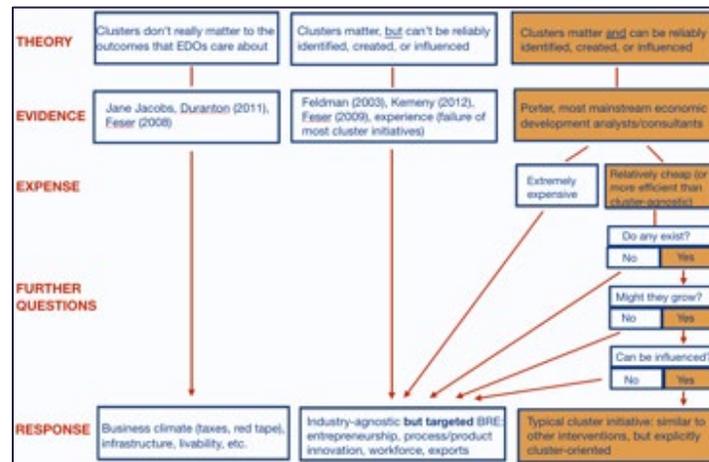
Clusters and Strategy

Fundamentally, strategy means making clear trade-offs among plausible alternatives for achieving a specific goal. This means that in practice, strategy primarily involves clearly and explicitly choosing what not to do. One way of determining whether a strategy is really a strategy is to consider the opposite of the stated strategy – if the opposite is clearly stupid, then it means that you haven’t actually rejected plausible alternatives. For example, “win the battle” is not a strategy, because the opposite is clearly stupid (“lose the battle”). Similarly, “grow the Akron economy by being the best location for innovative industries” is not a strategy because the opposite is clearly stupid (“allow the Akron economy to shrink by being a bad location for innovative industries”).

Akron’s leaders have a goal of putting Akron’s economy on a new trajectory. This means not just trying to grow the economy in its current form (as measured by job growth or capital investment), but to achieve true development: ensuring that Akron’s economy has the capacity to succeed in growing industries in which there is still a “window of locational opportunity”, firms are competing in terms of innovation and productivity rather than low price (resulting in high wages across the skill spectrum), and outside investment is flowing into the region.

This means that to develop a strategy, Akron must now consider the trade-offs between a set of plausible alternatives that could achieve this outcome. There are many theories about what causes economies to develop and attain new trajectories, not all of which embrace clusters as playing a crucial role. Because strategy is about choosing what not to do, if Akron is going to invest in a cluster initiative it must understand and clearly reject other theories. The three main theories that it must consider, and the basic approaches and trade-offs they each present, are detailed in the “decision tree” framework below.

Part 1: Competing Theories and Related Responses

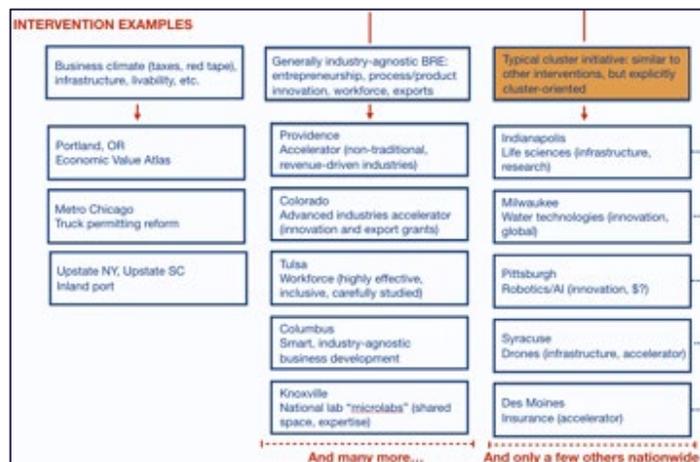


The three basic theories related to the role of clusters in economic development are as follows.

- **Anti-cluster:** regions don't benefit from clustering or specialization; there are at least as many downsides to having a cluster-oriented economy (e.g., greater exposure to industry cycles, increased labor costs for firms competing in the same industry) as there are upsides. The related response is to take an entirely industry-agnostic approach: making sure the general operating environment for businesses is good and minimizing barriers to entry for small firms, enabling the market to shift and grow on its own.
- **Cluster-agnostic:** clusters do provide meaningful economic benefits, but there's no evidence that a region can reliably guess which ones are likely to grow or could benefit from cluster-scale investment. The related response is to focus on the *conditions* from which clusters grow – entrepreneurship, innovation, or skills in any innovative or “advanced” industry or firm – without trying to actually identify specific favorites.

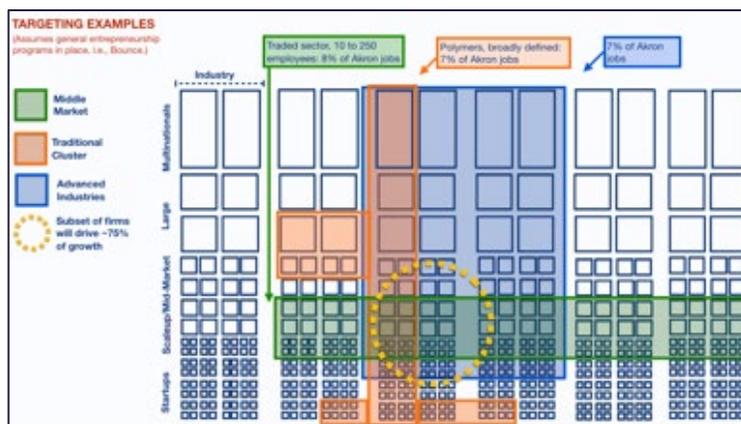
Cluster-centric: clusters really do matter, and if regions use the right methods they can pick the right ones. Because the related response – a full-scale cluster initiative – is riskier than the above two and often more expensive than other alternatives, this theory requires additional scrutiny before acting upon it. Specifically, there are four potential points at which a region might revert to a cluster-agnostic approach, even if it adheres to cluster-centric theory in principle. First, a region might revert to a cluster-agnostic approach because it recognizes that the expense of a cluster initiative simply exceeds the region's capacity. (Cluster initiatives have high fixed costs because they have to be tailored to the specific needs of the cluster, and then high implementation costs because they need to be at a cluster-wide scale.) Or it might realize that none of its industries meet the definition of a robust cluster, or that its potential target clusters are unlikely to grow, or that the growth/behavior of its potential target clusters are unlikely to be influenced by a cluster initiative. Only if a cluster meets all of these criteria should a region consider a cluster initiative. (The rest of this report walks through these criteria for the polymer industry in Akron.)

Part 2: Further Reasons for Scrutiny – Few Good Examples



The need to apply this additional scrutiny to cluster efforts is made more concrete by the above, which shows that there are few examples of successful cluster initiatives, and that each of those was an expensive effort. In contrast, there are many examples of successful cluster-agnostic approaches.

Part 3: Clusters Are Not the Only Way to Be Strategic



Despite the mixed track record of cluster initiatives, many regions unquestioningly forge ahead with cluster-oriented approaches because they believe that it is inherently the most “strategic” approach (focusing on one or two clusters offers the most logical way to decide what not to do). This is not the case. There are ways to make cluster-agnostic investments that are every bit as targeted as cluster-centric investments. In Akron, for example, a cluster-agnostic approach like focusing on mid-sized traded sector firms across industries (about 8% of the economy), or advanced industries firms of all sizes (about 7% of the economy), involves making as clear a trade-off as focusing on the polymers industry (about 7% of the economy). Further, following a cluster-agnostic approach does not mean neglecting the key firms within

an important cluster. In the above example, each of the three approaches would capture a set of small- to mid-sized firms in the polymer industry, because the most important firms in the polymer industry are likely to also be mid-sized and in advanced industries.

Designing Cluster Initiatives

This report is primarily designed to “pre-vet” whether the polymer cluster is suitable for *any type* of cluster initiative, not to identify which specific interventions or investments would be most suitable. However, it is helpful to have some basic concepts about cluster initiative design in mind while reading this report, because much of the pre-vetting involved trying to identify whether the cluster had problems or opportunities in these areas.

There are five broad areas in which most cluster initiatives focus. (The strongest cluster initiatives make investments in most or all of these areas). These areas are as follows.

- **Information and networks:** Some clusters have most of the right ingredients for success but suffer from both internal and external information gaps. Internally, there may be many firms with high capacity for growth and shared problems, but no forums in which to learn from one another, identify opportunities for collaboration, or establish priorities for collective action. Externally, firms and investors in other regions (including state and federal governments) may not be fully aware of the potential of the cluster or its needs, and therefore underinvest in it. Thus, internal collaboration/convening and external evidence-based promotion may be important interventions.
- **Talent development:** There are cases in which cluster-wide growth could be unleashed if firms had access to specific types of talent. Convening firms to define their specific skills needs and then working with educational institutions at every level – from K-12 to community colleges to universities – to build industry-relevant talent pipelines is a key feature of almost any cluster initiative.
- **Research and commercialization:** Clusters occur naturally in part because firms benefit from being close to peers and academic institutions so that they can take advantage of local “spillovers” from R&D. Especially when an industry or technology is rapidly evolving, crucial information is “tacit”, meaning that it is not yet codified and cannot easily be transferred to firms outside of the region. Yet the fact that R&D produces these public goods is also why firms also routinely under-invest in it – each firm has an incentive to allow others to do the hard work so that they can “free ride”. Therefore, coordinating R&D activities between universities, research labs, and firms can help unleash innovation that would not have otherwise occurred. Many cluster initiatives create intermediaries to help these entities overcome different incentives and cultures.
- **Infrastructure and place-making:** Historically, clusters often formed because firms in an industry benefitted from being near certain types of infrastructure, like ports or railroads. Firms still have shared infrastructure needs that cluster interventions can address. In some cases, basic underlying infrastructure like broadband internet could support cluster development. Other interventions related to research commercialization or talent development, for example, may require physical investments such as applied research labs or shared training facilities, for instance. Finally, an identifiable physical

presence can strengthen the cluster's brand identity and provide a tangible place where companies, researchers, and universities can interact and share learning.

- **Capital access:** Nearly all young firms, whose creation and growth is crucial to sustaining a dynamic cluster, need industry-relevant forms of capital in their early stages. But banks and other types of investors may not understand the particular needs of firms in a given cluster and may therefore underinvest. (This is a common issue for manufacturing startups, whose capital needs are larger and longer-term than consumer-oriented tech startups, which have access to many accelerators, incubators, and dedicated public/private funding streams.) Many cluster initiatives create intermediaries to play a “broker function” that helps connects startup and scaleup firms to needed capital.

III. Assessment of Akron's Polymer Industry

Approach and Data

Using a data and findings from interviews, this assessment walks through the key questions and logic model (described in the next section) to determine whether the polymer industry in Akron has the characteristics of a cluster that could put the regional economy on a new trajectory.

This assessment is thorough – it involved a scan of many sources of data and a range of in-depth interviews designed to capture a broad range of firms and perspectives – but it is not extremely technical. In particular, it does not attempt to strictly define the boundaries of the cluster or determine which is the most accurate of the many definitions currently in use. (Interviewees variously defined the cluster based on, in order of increasing breadth: specific applications of polymers like adhesives, polymers overall, advanced materials, or chemistry. Similarly, some sources of data are detailed enough that we were able to create an advanced materials or polymers analysis; some only allowed us to look at “resins” or “plastics” or “rubber”.) Nor does it attempt to definitively conclude whether the cluster is an Akron-centric or NEO-wide phenomenon. (Interviews and data could support either view.)

Where a specific definition had to be chosen in order to assemble data on the cluster, we generally took a conservative approach and only included the core functions of the industry (plastics and chemicals). This brought the risk of missing certain firms in supporting industries like logistics or marketing, or end-users in other industries that are a key part of the polymer supply chain. But, because the purpose of this assessment is to determine whether the polymer cluster clearly exceeds the minimum thresholds, it should not matter whether a single firm or tangential NAICS category was left out of the definition. If the cluster only technically exceeds the minimum threshold with the inclusion of a single firm or debatable NAICS category, then that in itself clarifies that it does not really have the ingredients for a cluster initiative.²

Summary – Key Questions and Logic Model

The following re-states the key questions that this report is attempting to answer for Akron's polymer cluster, as well as the logic model that forms the structure of this assessment.

Key Questions

- Do existing firms in the polymer cluster have meaningful shared needs and are they motivated to engage together in (and drive) a robust cluster initiative?
- If so, what – if anything – can the region's economic development organizations (EDOs) do to address these shared needs to accelerate the development of the cluster?
- Would it make strategic sense to pursue these opportunities, given that successful cluster initiatives are expensive, and the region faces significant resource constraints?

² For those interested, the OPSC 2011 Roadmap includes a very technical overview of the definition of the industry.

Logic Model

1. **Is the polymer industry a cluster?**
 - a. Scale: are there enough firms?
 - b. Proximity: are they close enough together?
 - c. Interdependence: do firms see their competitiveness as dependent on other firms?
2. **If so, is the polymer cluster worth prioritizing?**
 - a. How likely are firms to benefit from a cluster initiative?
 - i. Shared problem: among firms across the cluster?
 - ii. Motivation: among firms work collaboratively?
 - iii. Structure: do enough firms have innovative and executive capacity?
 - b. How likely the cluster is to grow?
 - i. Stage of development: is the industry emerging, established, mature?
 - ii. Specialization: is the cluster globally unique?
 - c. How likely the cluster's growth is to benefit the regional economy?
 - i. Spillovers: are innovations likely to benefit to other regional firms?
 - ii. Inclusion: are jobs created likely to be high-quality, low barrier?
 - d. Quality of existing programs relative to competitors
3. **Implications: what types of initiatives could the industry benefit from, at what scale?**
 - a. Interventions: what problems can be solved for firms?
 - b. Scale: organizing principle, strategic upgrade, or full-scale cluster initiative?

1. Is the Polymer Industry a Cluster?

A. Scale: Clearly Meets Standards

Our assessment of Akron metro area, based on Census data (County Business Patterns), reveals that there are clearly enough firms in the industry to meet the basic standards for a cluster. There are over 700 materials firms, of a range of sizes. Of these, 200 are in the polymer industry (strictly defined), and 160 of those are fewer than 100 employees. (See details below.) Robust cluster initiatives have been built around fewer firms.

- Materials, broadly defined (11 NAICS codes): **732 companies**
 - Of which mid-sized (10-99 emp): **365 companies**
 - Of which small (1-9 emp): **293 companies**
 - Small and mid-sized together = **650 companies**
 - Of which polymers (chemicals [NAICS 325], plastics [NAICS 326]): **213 companies**
 - Small and mid-sized polymers companies = **160 companies**

This assessment is basically in line with several Team NEO assessments of the broader region.

- 2016 Team NEO Asset Map for additive manufacturing: found 1,900 metal fabrication firms and more than 800 plastics processors in the region, as well as 500 local end-use customers in the aerospace, medical/dental and automotive industries.
- 2015 Team NEO report on polymer and chemicals firms concentrated around the Utica Shale in Ohio, Pennsylvania and West Virginia: found close to 1,800 rubber companies, over 1,100 plastics manufacturers, and over 6,000 chemical makers.
- 2011 Ohio Polymer Strategy Council “strategic opportunity roadmap” identified over 2,400 polymers and advanced materials establishments in the state.

B. Proximity: Clearly Meets Standards

While many interviewees, and several of the above analyses, suggest that the broader Northeast Ohio region is the appropriate geographic level for understanding the cluster (and perhaps the appropriate geographic level for designing interventions), it is nevertheless clear that Akron alone has enough companies in close proximity to one another to qualify as a cluster. Based on the above assessments by Team NEO and OPSC, with about 700 companies, Akron alone contains on the order of 15 to 25 percent of the state’s total materials industry.

C. Interdependence: Meets Standards, But Inconsistently

The most robust clusters exhibit high levels of interdependency among firms in each of the below categories, to the extent that firms are convinced that their success depends on being in the region they are in. Firms in Akron’s polymer industry demonstrated relatively high levels of interdependency on just one of the three categories (occupations and skills), medium levels on one (technology and know-how), and relatively low levels on one (product and supply chains). More detail on each of these is below. **This raises a theme that will be repeated throughout this assessment: that Akron’s polymer industry, for a variety of reasons, is less interconnected than would be expected given its scale, proximity, and history.**

Product or supply chains: with a few exceptions, interviewed firms clearly indicated that they neither sourced a significant portion of their inputs from local suppliers, nor sold a significant portion of their outputs to local customers. The fact that key firms do not have many local customers is not a bad thing – it is to be expected, given that interviews focused on export-intensive firms. It is, however, important to understand because it indicates that supply-chain based interventions are unlikely to be desired by firms or highly effective.

- One firm, which mostly did repair/maintenance work for industrial components and would therefore be expected to be more locally oriented, reported that 50 percent of their customers are local, representing 30 percent of their gross revenue.
- A scale-up traded-sector firm that is developing and marketing highly innovative coatings noted that: *“We don’t anticipate finding local customers. We have to go where the customers are and they are across the*

U.S. in industries like automotive, aerospace, oil and gas, and industrial manufacturing. It would be wonderful if all our customers and raw materials came from Akron, but that's not the case.”

- Another traded-sector firm that does contract manufacturing and precision molding with engineered resins for a variety of industries noted that most of their clients are located out of the region, and that most of their polymer vendors are outside the state as well. They chose to locate in Akron in part because the density of tool and die shops that were taking advantage of apprenticeship programs and vocational training from the local schools, but now find that most of those tool and die shops are no longer in business.
- A biomedical polymers firm attempted to find local supply chain companies that they may be able to contract with but could not find any and are now working with a manufacturer in the Philadelphia area.
- A relatively large manufacturer (approximately 150 employees) that would be thought of as a “polymers” firm locally indicated that it considers itself more as part of the supply chain of its end-user (it is a second-tier supplier). It indicated that it has few peers (i.e., competitors) in the region, and that its customers are all outside the Northeast Ohio region (end-users in Europe and first-tier suppliers in Mexico).
- Another relatively large manufacturer (approximately 100 employees) noted that 10% of their customer base is in Northeast Ohio (even though that includes Goodyear and Bridgestone). They have distributors working on their behalf all over the world.

Occupations or skills: despite the wide variety of separate technologies that comprise the polymer cluster, firms in Akron rely to a significant degree on similar skillsets and draw employees from the same few sources (most prominent by far being the University of Akron). Notably, firms in almost any industry in almost any region complain about workforce quality and quantity, but interviewees in Akron expressed almost no concern whatsoever about their ability to hire mid- to high-level talent. Several firms further noted that technicians, engineers, and researchers can and do move seamlessly between firms working in different segments of the industry. Talent, therefore, is clearly shared among firms and a reason that firms locate and grow in Akron. Several firms did note challenges hiring less-skilled workers, but this was largely a concern of firms producing low-cost commodities and therefore paying low wages (and in any case, finding reliable workforce at \$11 to \$13 per hour range is a challenge in any region).

- A representative of the University of Akron (UA) noted that the majority of the university’s 300 graduate students are recruited by local firms, confirming the high degree of dependency upon UA talent by a range of polymers firms.
- A representative from a major multinational firm indicated that it is reliant on local hiring because employees recruited from outside the region tend to “bolt” for other, larger metro areas. However, this is not at all problematic: over a third of their researchers (with graduate degrees) come from UA, as do a large portion of their bachelors-level employees (“they can keep up with any Big 10 engineer”), and they benefit from having 30 co-op students from the U of A. This reinforces the fact that the UA produces sought-after talent at numerous levels and functions.
- A representative of a different major multinational firm confirmed that the UA is a good source of bachelors-level employees. They also noted, however, that PhDs are recruited from outside the region

and rarely move between firms locally. The dependence on local sources of talent, therefore, may not extend to the highest skill levels. (This is not problematic in the sense that PhDs are a small portion of the workforce but is potentially problematic in that the churn of PhD-level talent among firms in a region is a key feature of the most robust clusters.)

- That said, at least one early-stage startup indicated that PhD-level talent would be an important factor if they were to grow in Akron: *“There is no other place that has a bigger PhD program. The number of grad students has been reduced a bit...but I see it coming back. This is important. I need a backbone of people who can talk about the science. This is not something you could do in many other places.”*

Technology or know-how: a small portion of the Akron polymer industry could be considered part of the industry’s “innovative core.” These are the firms that invest significantly in R&D and work in nascent or emerging portions of the industry. Although this is true of most industries on a percentage basis, it is notable in Akron because, given the relatively small size of the market, there are likely 50 firms or less that are engaged in the type of innovation that cluster initiatives tend to target. What is more notable than the *amount* of innovation occurring, however, is the general lack of interdependency among firms when it comes to innovation – few firms indicated that Akron provides an innovative “ecosystem” where ideas are exchanged informally between firms and companies benefit from knowledge spillovers. The major reason is that many firms are competing in fairly mature industries, in which the differentiation between firms is smaller and they are consequently more defensive. The only exception to this lack of interdependency is the University of Akron, which nearly every firm indicated is – or could be – a crucial, shared resource for product and process innovation.

- A interviewee from a large polymers firm noted that the *maturity* of the tire industry has much to do with the lack of a dense “ecosystem” for innovation in Akron: *“It used to be that there was a number of experts at UA doing groundbreaking [on polymers]. They’d create fundamental knowledge that firms like [this one] can’t justify investing in. Since then, the industry has matured, the big questions are well understood, so R&D moves in-house and becomes more developmental. The difference between here and a place like Rochester is that in Akron, the final product (tires) is almost the same across the major firms, so it’s too dangerous to the business to share research.”*
- In a statement that concisely captures the concerns of most players in the tire industry, a representative from a large firm said: *“We’re all scared to death that Goodyear is going to steal one of our inventions.”*
- The consensus is there is little interdependency among tire firms when it comes to innovation. However, as a UA representative pointed out – and as many smaller firms agreed – there are other areas that are more nascent and where cooperation is more likely: In areas like biomedical and recyclable polymers *“even big firms could come together. In mature industries, differentiators are smaller and firms are more defensive, whereas in areas like biomedical firms are more open... there might be shared challenges with recognition of mutual benefit and no competition.”*
- For companies working in these “more open” areas, there is little indication of joint innovation with one another or with larger firms. However, there are strong indications that these firms depend heavily on UA – that is the one locus for interdependencies in terms of technology and innovation. One startup firm asked, rhetorically, whether Akron was *“the right place to start a materials science company”* and answered *“there is no other university system that has so many materials science professors in one place. If*

you run into materials science problems, this is the place you go to.” Another scale-up firm went further, noting that UA was the only unique benefit of being located in Akron: “UA has some very capable technologies and professors that provide insights that I couldn’t get other places. The rest of Akron is not something that I really need to be competitive. The other benefits of being located here are limited...”

- It’s important to note that technology and know-how doesn’t just relate to technological innovation. Mentorship by experienced business leaders can also help define a cluster. One small firm pointed out that: *“The largest barrier that exists in the region is the lack of mentorship. The intellect is available in the region to develop new products but the mentorship in bringing an idea through the process to market is lacking. We have had a great relationship with Jumpstart; they are a very powerful tool in the ecosystem for financing but not mentoring.”*

Summary: Is the Polymer Industry a Cluster?

Category	Result	Evidence
Scale	Clearly Meets Standard	750 companies
Proximity	Clearly Meets Standard	May extend to NEO, but definitely adequate proximity in Akron
Interdependence		
Supply Chains	Does Not Meet Standard	Firm interviews - very little local purchasing of inputs, services
Skills	Clearly Meets Standard	Firm interviews - major shared dependence on U of A
Technology	Barely Meets Standard	Firm interviews - few innovative firms, centered on U of A (no “ecosystem”)

2. Is the Polymer Cluster Worth Prioritizing?

A. How Likely Are Firms to Benefit from a Cluster Initiative?

Shared problem: because there are fairly large divides within the polymer industry, between companies of different sizes and companies that focus on different technologies, it is difficult to identify shared problems across firms. Later, we will discuss shared problems that do exist among specific subsets of firms, but overall firms in the cluster do not have a consistent set of growth barriers (which implies that no single intervention or investment would benefit more than a fraction of the overall industry).

- One leader with significant experience in the industry and in leading related economic development initiatives noted that: *“The challenge for Akron if it goes after this cluster is its maturity and its scale – it’s a difficult candidate for the region to attack as one industry.”* An executive at a startup that has worked for decades in other parts of the industry across Northeast Ohio made a similar observation: *“It seems like a cluster initiative would be a very difficult thing to try, because the industry itself is so vast – there’s so many different applications and things that firms are going after.”*

- An executive heavily involved in the creation of Polymer Ohio expanded on the scale and complexity of the industry, and how that makes finding a shared problem difficult: *“the reason that we founded Polymer Ohio is that we saw we had this giant industry that is vital to Greater Akron and it needed some new growth firms and new technologies, but the State of Ohio didn’t know quite what to do with it or how to help it, even though it is big.”*

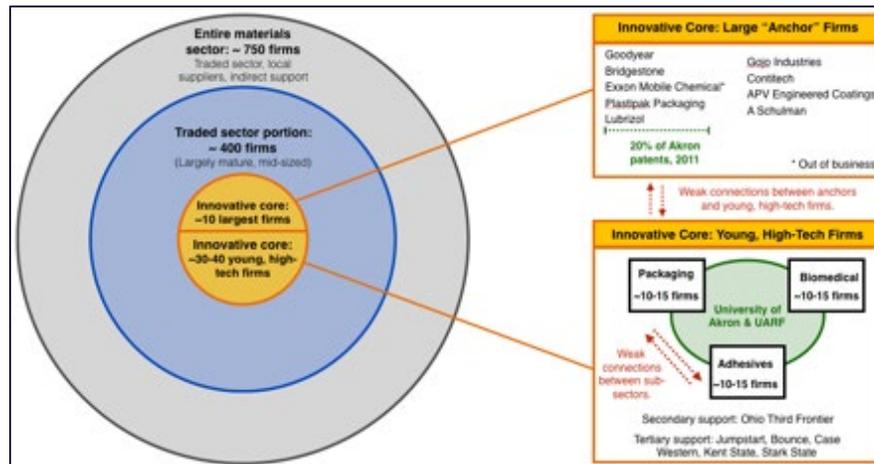
Motivation: in interviews, most firms indicated little proactive interest in being part of a cluster initiative or consortium. Some – especially large firms in more mature portions of the industry – even indicated that they would be highly skeptical of working with their competitors in any way, because they differentiate based on small differences and therefore hold their IP closely. Another commonly cited point among large firms was that they didn’t need to collaborate with peers because they have research groups and university partnerships across the world. Again, later we will discuss the specific subsets of firms that expressed interest – but overall there was little enthusiasm for the idea of structured collaboration or problem-solving in the industry.

- The largest firms generally expressed the same sentiment, which is that they are not reliant on the regional “innovation ecosystem” for their competitiveness: *“Realistically [for external innovation] we tend to go where expertise is. It’s great when it’s someone that’s just a drive up the street, but it’s just as easy to find them in Beijing or Shanghai or St. Louis.”* (This reflects the fact that these firms are largely working on incremental innovation, which is easier to perform across distances than “disruptive” innovation.)
- One relatively large, relatively innovative firm (not a household name, but certainly important in the context of Akron’s economy) put it bluntly: *“We don’t want to create competitors by joining a consortium.”* An executive at a peer firm (of similar size and importance in terms of innovation) was less defensive but agnostic nevertheless: *“If a cluster initiative could help retain people or businesses, I’m excited about it – I just want people to come to Akron, I don’t care what it is.”* (This executive went on to say that the reasons that his/her firm was in Akron had little to do with collaboration with other firms or institutions, noting benefits like time zone, cost of living, hospitals, and universities.)
- While in general smaller, highly-innovative firms were the most interested in collaborating with peers, some of the most innovative small firms had their sights set outside of the region. One such firm said: *“In our industry, the big companies we’re looking to partner with are in the pharmaceutical and medical industries, which are all over the country... our partners have no connection to Akron. And though we might work with manufacturers, currently our main manufacturer is in [large East Coast city] because our [high-level executive] lives there.”*
- Then at the other spectrum are companies that are risk-averse and not outward-looking. According to a service provider: *“A lot of companies are 3rd or 4th generation, with a midwestern aversion to being bold. They are comfortable being suppliers to the innovative companies. And unfortunately, some of the companies that ARE innovative can be tight-lipped. They’re trying to solve their own problems internally.”*
- A representative from a university noted that the lack of motivation for collaboration and engagement extends beyond just firms, to firms and government: *“the industry does what it does, the industry is stuck in its own box, federal funding is declining, and there hasn’t been much focused investment from the state or city. Companies come to us individually with small research grants or requests – \$1 million here and there – but they’re not coming in collectively, at scale.”*

Structure: As noted, cluster initiatives generally involve firms that are heavily engaged in innovation – which means firms that are headquarters establishments, R&D operations, or manufacturers that have the capacity to engage in process innovation. And as described earlier and above, Akron’s cluster is not currently bound together by strong interconnections between firms when it comes to R&D. But to understand what possibilities exist for a cluster initiative, it is important to understand more about the structure of the cluster. In other words, which types of firms are innovative and open to collaboration, and how many are there? A key reason that the structure of the cluster matters is that successful cluster initiatives not only involve innovative firms; they involve firms that are either headquarters or have some executive functions, and are therefore able to steer resources towards the effort (by contrast, branches of large firms often have little autonomy to engage in and contribute to local efforts). Large firms with executive positions also tend to provide the private sector “champions” for the initiative, which are key to the success of cluster initiatives.

- The below graphic answers the “which type and how many” question. Within the “innovative core” of 50 firms described previously, there are important structural breakdowns. First, there are about 10 large, highly innovative firms. A subset of five of these accounted for 20 percent of the entire Akron region’s patent production in the few years leading up to 2011. There are relatively few connections among these firms, nor between these firms and the smaller firms in the innovative core. This other group of 30 to 40 smaller firms in the innovative core breaks into three separate, equally-sized categories: packaging, adhesives, and biomedical. These separate categories all revolve around the University of Akron, but otherwise don’t have much to do with one another.

Overview: Structure of Akron's Polymer Cluster



- One PhD student and startup founder described the structure of the cluster in terms of innovation as follows: *"There are a lot of 50-75 people companies in NEO that are doing something very traditional and they want to stick to it. This is probably 95 percent of firms. The only ones in the R&D economy are the big companies who want to, and the small companies who don't have an option. The middle sector is missing."*
- In terms of leadership, several large firms (probably correctly) pointed out that the involvement of the region's very largest firms (the largest of the large) would dictate whether other major firms got on board. One of these very largest firms, however, indicated that its strategy and structure meant that it would be unlikely to engage heavily. So not only would this firm be unlikely to lend leadership to the effort, but its lack of engagement would also discourage other large local firms from championing it. This firm noted that *"We're committed to tires. We have a huge infrastructure invested in making tires, we've been doing it for 120 years."* To the extent that it does explore areas outside of tires, it is more reliant on external innovation, but is able to tap into a well-established global network of experts and is therefore not reliant on the local ecosystem. It has worked with Jumpstart and Ohio Third Frontier to find local partners but has mostly returned to using this global network.
- As has been touched on in the section on skills and technology interdependencies (pages 15-17) and will be discussed again in the section on specialization, the lack of major corporate involvement means that some other large institution will have to step into this void. It appears that the only candidate is the University of Akron. This is evident in the fact that the university is invoked throughout this document in terms of its role in producing skilled workers, technology transfer, and in providing shared services. But it was also suggested directly by firms, including one large, highly innovative company with growth potential and a stated desire to be involved in a cluster initiative: *"I think the central hub that's neutral is the University of Akron. They have people, facilities, and could be a networking hub that this cluster could revolve around. But I don't think that it's close to being an organized structure right now."*

Summary

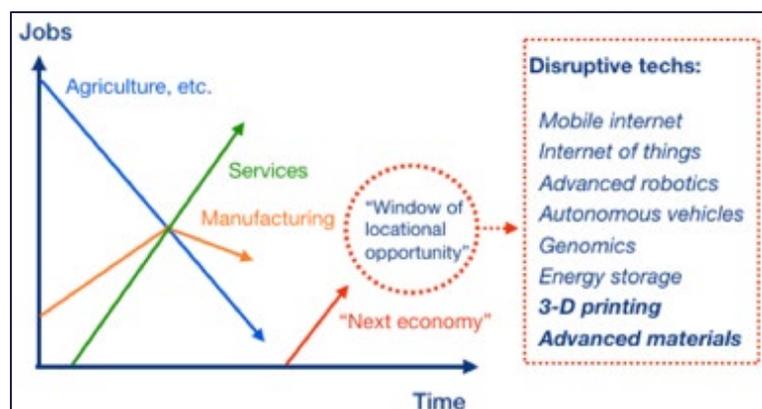
Are Firms Likely to Benefit from a Cluster Initiative?

There are not cluster-wide shared problems, nor cluster-wide motivation to collaborate. Notably, the largest firms do not perceive that their problems can be addressed locally, and are not motivated to engage. However, there are enough firms that do have shared problems and motivations, and enough of them are innovation-oriented and possess high-level executive functions. For these firms, the “center of gravity” is the university, not large corporations.

B. How Likely Is the Cluster to Grow?

Stage of Development: according to McKinsey, advanced materials (of which certain types of polymers are a part) are one of a dozen “disruptive technologies” that define the “next economy”. (3D printing, an adjacent technology, is on the list as well.) This, combined with the fact that Akron has at least some innovative research and commercial activity in potentially “disruptive” polymer technologies, would indicate that there is reason to prioritize the polymer cluster. Interviews not only generally supported the idea that polymers are poised for growth, but also shed light on specific areas of growth in which Akron may be well positioned.

The Next Economy: Technologies with a Window of Locational Opportunity



- A university representative noted that there’s broad optimism about the growth potential of the industry: “We’ve evolved from rubbers to plastics, and we’ve gone through phases where we thought we knew everything and the industry was mature, but now we’re coming to an upturn. There’s new stuff happening in three or four areas, where there’s market failures and firms (even big ones) could come together to address them because there’s less competition.” Three of these areas were mentioned previously: packaging (recyclable/”disappearing” plastics), biomedical applications, and biomimicry (which includes adhesives applications). Many other interviewees repeated this basic categorization of emerging technologies. This university representative noted that these areas are where the university has increased its hiring.
- Adding to the general tailwinds, there are key firms in Akron that have an imperative to innovate. One very large firm noted that: “The status quo is not viable. We’re on a 5-year plan. If we can’t develop 1-2 strategic polymers a year, we’re selling the business.”
- There are also indications that mid-sized firms are doing important incremental innovation. One firm described a prototypical “advanced material” product that it patented: a woven polymer that can be welded or molded, is 40% lighter than plastic, and is used in cars and HVAC systems because it resists condensation.

- As noted in the structure diagram (page 20), however, Akron’s cluster is not highly innovative even if the industry globally is. One person affiliated with a university noted that perhaps too much of the innovation in Akron is incremental, because the largest firms are risk averse (they don’t want to put radical new technology on cars going 75 miles per hour). Further, this person described that some of the emerging technologies described above are highly price sensitive, so even the most innovative products which might sell for 50% or 100% over market rate are only worth \$5 to \$6 per unit. This makes it hard to reap the benefits of innovation.

Specialization: overall, the widely held perception that Akron’s polymer cluster is unique is shared by firms (many perceive Akron to be among one of just a few areas where they could locate) and also borne out by data.

- Data on exports, FDI, and patents all support the view that Akron does have a meaningful specialization in the polymer industry. For example, combining the data for Akron and Cleveland (reasonable, as they function as one market), the region’s polymers exports in 2017 were about 150% of the next largest metro areas (Detroit and Charlotte). **See appendix for more.**
- To summarize the optimistic view of the cluster’s uniqueness, what follows is the assessment of an experienced industry and (former) economic development leader: *Akron is at the center of truly one of the country’s more obvious industry clusters. You can find most layers of the supply chain, ancillary services, two strong research universities, corporate research centers... it’s a great cluster to study.* While this is somewhat overstated, it is important that leaders in the region still have this belief, and would therefore be willing to back a potential cluster initiative.
- Numerous interviewees indicated that the university was at the heart of Akron’s specialization, and only referenced other locations with university programs as potential competitors. An experienced executive at a university spinoff said: *“In polymers, I would say that UA is unique. There are other places, maybe five to ten, that are centers of this as well. For coatings, it would be Michigan State, University of Southern Mississippi, University of Missouri-Rolla... they have the professors, the technology, and the industries.”* A person who works with small polymers firms said: *“I’m not certain that there’s something absolutely unique about Akron. Companies stay because they have family here or to be near the university. Right now, our advantage is that firms have the ability to work with UA; they won’t leave because they know how to navigate it.”*
- One major benefit of focusing on a specialization is that startups that form in the region are less likely to leave as they mature. One polymer startup pointed out that a computer science-based company was formed in Akron, but “poached” by Silicon Valley. That would rarely happen with a materials science-based company, mostly because Akron has the people and expertise, but also because growing these firms is expensive and therefore of less interest to venture capital in coastal tech markets.

Summary

Is the Cluster Likely to Grow?

There are not cluster-wide shared problems, nor cluster-wide motivation to collaborate. Notably, the largest firms do not perceive that their problems can be addressed locally, and are not motivated to engage. However, there are enough firms that do have shared problems and motivations, and enough of them are innovation-oriented and possess high-level executive functions. For these firms, the potential “center of gravity” is the university, not large corporations.

C. How Likely the Cluster's Growth Is to Benefit the Regional Economy

Spillovers: the “spillover effects” that justify cluster interventions typically occur either when talent circulates between firms (or between universities and firms), or when firms directly collaborate with other firms or universities. Either of these allow firms to benefit from each other’s investments in R&D, skills, or infrastructure, effectively lowering the cost of doing business in the region.

- As already described throughout this document, there are currently few indications that firms collaborate directly with one another, and there does not seem to be much “churn” in the labor market (skilled workers don’t frequently move between firms). One high-end contract manufacturer interviewed reported an average employee tenure of 17 years, for instance. (This data was not collected in all interviews but does not seem extraordinary.)
- While these limit the potential for robust spillovers between firms in Akron, UA could potentially make up for this by positioning itself as a central hub for the cluster.
- Another indicator that spillovers are possible is that the technologies that firms in the “innovative core” are working on appear to be both complex and related. In other words, firms are working on developing technologies that are complex enough that they are likely to benefit from collaboration, but those technologies also stem from the existing knowledge base in the region – so firms outside the “innovative core” may have the capacity to learn from elite firms and apply those lessons to their own businesses.

Inclusion: As economic inclusion becomes a top priority for Akron, EDOs should start to assess the potential benefits of any investment through the lens of “who benefits”. In other words, is a cluster initiative likely to directly benefit the populations that are currently excluded from the economy or from the benefits of growth? Put more concretely, if polymers firms grow as a result of the region’s investments, are they likely to create jobs that are accessible for lower-income, lower-skilled workers? This is a topic that requires much more research (potentially as part of the creation of an inclusion narrative and business case). Based on interviews, it does not appear as though the firms at the core of the cluster offer major, direct opportunities for economic opportunity – there was little indication that their growth would lead to the creation of many middle-wage manufacturing jobs, for instance. However, a focus on the cluster could still be justified in terms of its indirect effects on inclusion – inclusive growth is only possible if growth is occurring, and the polymer cluster is a potentially crucial engine of growth.

Summary

Is the Cluster's Growth Likely to Benefit the Regional Economy?

There are few reasons to believe that investing in the polymer cluster would have major near-term spillover effects across the entire industry or create many near-term jobs for disadvantaged populations. However, as the region's main traded-sector cluster, the industry is likely large enough and important enough that investments in it are warranted, even if only to preserve current jobs that are directly and indirectly supported by the industry.

D. Quality of Existing Programs Relative to Competitors

Note: this report was designed to focus on assessing the Akron polymer cluster itself, not on assessing the scope and quality of the economic development initiatives that impact it, or such initiatives in other regions. This section is based on an initial review informed by our experience in other markets and should therefore be treated as a starting point for further research.

Regional initiatives: relative to other metro areas, the Cleveland-Akron region has a set of basic economic development services for the cluster to draw upon that are currently about average, but with room to improve. In terms of entrepreneurship, Jumpstart and BioEnterprise are strong, and through Jumpstart and improved BRE those services should be brought to Akron. Team NEO and Cleveland Plus have fairly strong knowledge of the cluster (compared to typical regional EDOs) and have placed some focus on it, although primarily through the lens of additive manufacturing and shale.

Regional universities: the university assets of the region, if added together, are as strong as any of Akron's peer regions. By one measure – number of federally-funded R&D projects containing the terms “polymer and material” – the University of Akron ranks 12th of all U.S. institutions, Case Western ranks 26th, and combined they would rank 4th among all U.S. universities (after MIT, University of Michigan, and Georgia Tech). However, it appears that the problem is that it is *not* currently justifiable to treat these universities as one “distributed but collaborative” entity. One professor noted that while professors at Case Western, University of Akron, and Kent State all know each other, they perceive one another as competitors and don't work in close collaboration – though they might be willing to organize around a common goal.

- UA is already widely recognized in Akron for its crucial role in sustaining the cluster and has decided to reinvest in polymers. It is hiring four new faculty with an emphasis on emerging technologies, even as the university reduces or eliminates other programs.
- Case Western's department of Macromolecular Science and Engineering has the first bachelor's degree in polymers, CLiPS (an NSF-funded center for “layered polymeric systems”), and the Institute for Advanced Materials (one of the state's 50 Centers of Excellence, to which Sherwin Williams recently donated \$1 million). Saint Gobain, a French plastics company with a plant in Akron, hosts a design challenge at Case every year in which \$10,000 is awarded to the winners. Its Weatherhead School of Management has organized innovation challenges with Goodyear.
- Kent State is refocusing its liquid crystals efforts around new applications, as the display industry is now mature – these new applications include biological applications, fabrics and sensors, and electro spinning. An interviewee noted that 10 years from now, the Liquid Crystals Institute will be in the same place with materials and fabrics as they currently are with displays. That interviewee also pointed out that despite several previous initiatives that tried to foster cross-institutional collaboration, including a Commission on Higher Education and NorTec, there is currently little collaboration.

State cluster-oriented initiatives: Akron benefits from a state economic development and university system that is stronger than most (including entities like Ohio Third Frontier). The question is whether Akron is linked to these sources of services, expertise, and funding.

- The University System of Ohio manages 50 Centers of Excellence across the state university system in six technological areas, one of which is Advanced Materials and Sensors. Four of the six universities with Centers of Excellence in that area are in Northeast Ohio – the most important player outside of Northeast Ohio is The Ohio State University, which is investing \$60 million in an Advanced Materials Corridor (focused on materials science, biomedical engineering, chemical/biomolecular engineering).
- The state also runs seven Ohio Edison Technology Centers, which are MEPs with industry-specific expertise, one of which is Columbus-based Polymer Ohio.

Initiatives in competing regions: the key question is, what should the above efforts be compared to? A number of states and regions claim “advanced materials” or similar industry/technology areas as priority clusters. The data in the Appendix reveal that Akron’s closest “peers” are Grand Rapids (MI), Greensboro (NC), and the Greenville-Spartanburg (SC) area, also known as Upstate SC. Of these, Grand Rapids is known as having high-capacity economic development institutions generally but no particular focus on polymers or materials. Upstate SC, however, has very robust cluster-oriented initiatives that likely exceed Akron’s, if not in size then certainly in momentum. The key elements are summarized below.

- At the state level, South Carolina identified six key clusters, one of which is advanced materials and nanotechnology. Each cluster has numerous research centers at the state’s research universities, each headed by an endowed chair that works directly with private-sector partners on commercially relevant innovation. (These are likely comparable to Ohio’s Centers of Excellence.) One example is the Polymer Nanocomposites Center of Excellence, which since 2004 has received \$3.5 million from the state and raised an additional \$17.4 million from outside sources. Michelin is one of its key private-sector partners.
- At a state-wide level, this is impressive, but not entirely unique. What is noteworthy is how these universities have acted at the regional level, in collaboration with firms and EDOs. The best example of this is likely the Clemson University Center for Automotive Research (CU-ICAR), a 250-acre talent-development and applied research center with 14 dedicated staff (plus another 46 at the university’s Department of Automotive Engineering). Working in concert with the Upstate Alliance (regional EDO) and local technical colleges, its mission is to: “be a high seminary of learning in the field of automotive engineering; lead translational research, with emphasis on industry relevance, and support excellence in basic research; contribute to high value job creation in South Carolina; and lead global thinking on the sustainable development of the automotive sector.” Over the past decade, it has graduated more than 400 students from M.S., Ph.D., and certificate programs and partnered with 33 firms on industry-relevant research.³
- Now Clemson and the Upstate region are in a position to translate this extremely successful model to the field of advanced materials (like Akron, the region has a history in materials – textiles specifically – and also has a major and highly engaged tire manufacturer in Michelin). Clemson’s Advanced Materials Center is 111,000 square feet (this may not be a meaningful comparison, but for context, the NPIC in Akron is 42,000 square feet) and has received funding from the NSF, DOD, and NASA. In 2017, a team of researchers led by Clemson faculty received a \$20 million NIH grant that will be used to establish the Materials Assembly and Design Excellence (or MADE in SC) initiative. Clemson will

³ For more, see a detailed case study at: https://www.brookings.edu/wp-content/uploads/2018/07/201807_Brookings-Metro_Rethinking-Clusters-Initiatives_SC-CUICAR.pdf

receive \$6 million and use it to hire five new faculty and support 12 doctoral students. Areas of focus will include responsive polymers and biomaterials, and companies involved include BMW, Boeing, Michelin, and others. This could, in effect, be the beginning of a materials cluster initiative that draws from the CU-ICAR model – which would go a long way towards making Upstate a truly globally-competitive region in the polymers and materials industry.

Summary

Are Northeast Ohio's Cluster Initiatives High-Quality Compared to Peers?

In general, with the exception of South Carolina, it would seem that Northeast Ohio is as well positioned as any region in terms of its cluster assets and initiatives, assuming that all of the regional and state assets and initiatives outlined above are actually functioning as intended and aligned with one another. This is a major assumption that needs to be examined further – many states and regions have excellent assets that are worth less than the sum of their parts because of lack of collaboration and alignment (or even competition between cluster-related entities).

Summary: Is It a Cluster Worth Prioritizing?

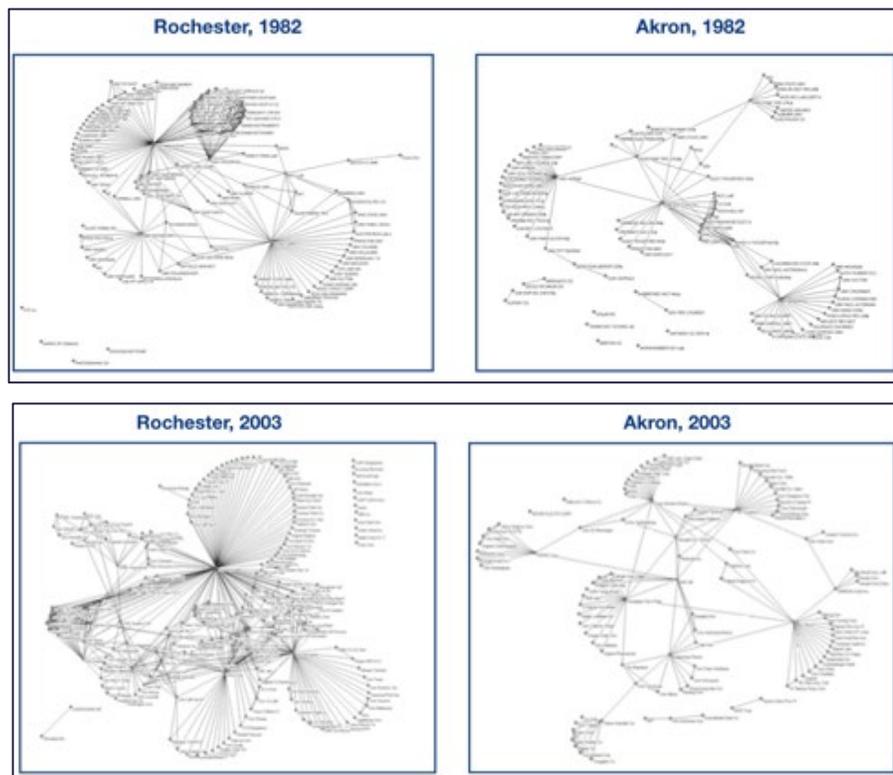
Category		Result	Explanation
How Likely Are Firms to Benefit?	Shared problem?	Yellow	Too many different end markets
	Motivation?	Red	Firms are competitors
	Innovative firms?	Yellow	Small share of total, but enough
How Likely Is Cluster to Grow?	Stage of development	Green	Numerous emerging opportunities
	Specialization	Green	Akron clearly a top market
How Likely Is Growth to Benefit the Broader Economy?	Complex/related	Green	Many firms "branching" from existing strengths
	Types of jobs	Yellow	Relatively few production jobs in high-growth firms
Bonus: Existing Efforts	Status/quality	Yellow	Good general services, cluster initiatives weak

IV. Implications: Potential Areas for Interventions

Note: The point of this report was to assess whether the polymer cluster should be considered a potentially viable option for a transformative investment; not to define exactly what the right strategies or interventions are. (In other words, it was designed to clarify whether it is worth spending the time and resources to even explore what interventions are necessary.) Of course, knowing what types of interventions the industry might need (and how much they would cost and how many firms would benefit) would influence the decision as to whether it is worth exploring as a potential focus. Therefore, while slightly beyond the scope, this section provides an overview of the types of interventions that would likely be part of a cluster initiative, and the final section provides an example of the basic structure and staffing that would be required. The five potential areas of intervention are presented below in approximately order of importance, assuming that decisions are being made on a three- to five-year timeline.

1. **Information and networks:** one of the major barriers to the creation of a more robust polymer cluster in Akron is one of the simplest and least expensive to resolve – which is the fact that firms and institutions don't know each other as well as they should and therefore miss out on opportunities to collaborate. The goal of interventions in this area would be to create broader and denser networks among firms, as Rochester did for its optical electronics cluster over the past several decades (as Akron's innovation networks became less robust).

Lack of Strong Interdependence in Akron: Innovation Networks in Rochester and Akron



Source: "[Searching for Silicon Valley in the Rust Belt](#)", Sean Safford

Sidebar

Comparing Knowledge Networks in Rochester and Akron

The below quotes are from the Sean Safford paper cited immediately above; they describe how facilitating collaboration and knowledge exchange can – aside from any other “tangible” investments – make a huge difference in the trajectory of regional economic development.

“Akron’s local knowledge network in the 1980s was remarkably insular and yet, at the same time, remarkably disconnected... [by the 2000s] Akron’s [knowledge network] has grown, but only a little, from 85 organizations in the 1980s to 100 today. In Rochester, the number of organizations in the network doubled from 104 to 249. In terms of the number of academic publications, the differences are even more striking with only 166 publications and 377 unique authors in Akron (a decline from the 1980s), compared to 516 publications by 795 unique authors in Rochester (nearly double the number in the 1980s).”

“...The key element of Rochester’s relative success was the willingness of companies to engage the university—and subsequently, local firms—around substantive, creative, and intellectual ideas. The university’s approach – particularly its emphasis on facilitating interactions among firms – was an important factor in making this possible. Through the creation of consortia and the encouragement of joint work between university and industry researchers, the university-built relationships among local actors that generated a higher level of trust. This trust, in turn, led companies to interact with local organizations not just as suppliers—as had been the case in earlier eras—but around ideas as well. Akron’s approach, which centered on generating new ideas and knowledgeable people with the goal of injecting these into the local economy, failed to achieve its intended result. Industry, it turned out, already had ideas and the university was already doing a good job of producing highly capable engineers and scientists. What they lacked was the forum for interaction among companies which the university—as was the case in Rochester—was uniquely situated to provide.”

“... what this research shows is that communities can affect the tenor and trajectory of regional economies through a concerted, organized, organizing approach.” (Emphasis in original.)

These lengthy quotes are included because local firms themselves repeatedly emphasized similar points; they recognize the need for a “concerted, organized, organizing approach”.

- Someone deeply involved in the creation of Polymer Ohio said that firms need to, and want to, be part of this organizing approach: *“We found at Polymer Ohio that when we put on programs everyone’s favorite part was not the programs themselves, but opportunities for companies to meet each other. The Chamber could do this well. Clusters aren’t planned; they happen, they are very organic. You just have to do some things to get people interacting with each other. They will then find what they have in common.”* A representative of one of the largest polymers firms in the region reinforced this view. He argued that while the university’s role is key, firms have a responsibility to play a proactive role in determining their needs: *“Industry needs to determine what it wants, and then the university can deliver.”*
- In reality, firms tend to overstate their ability to self-organize. Every successful cluster effort has dedicated staff that handle the hard work of convening firms, clarifying problems, connecting firms to other institutions, and so forth. The UA Research Foundation has begun doing some of this legwork: *“We have put together lists of industry collaborators... such as firms that are underutilizing equipment, or firms that are stagnant and therefore perhaps more open to collaboration.”*
- One challenge for any such “organizing” effort will be identifying the subset of firms that are willing to contribute and likely to benefit. The convener would, according to an executive at a startup based on university research, would need to be able to reach into the industry overall but *“focus on finding areas where companies could focus on coatings, biomed, and packaging.”* Another executive at a university spinoff made a similar point: *“would firms benefit from coming together and working through a research institution? Yes! Are they doing it today? No. These lost opportunities especially affect the middle sector [mid-sized, semi-innovative firms]. Food packaging and medical films have shared problems, but they’re not working together to figure out new technologies in the field – they want to keep all their knowledge in-house.”*
- Another challenge will be to change the culture at UA so that it becomes more of an open “platform” or “hub” for the cluster. To be sure, both sides are responsible for the frictions that are involved in university-industry collaboration. But regardless of which side is “at fault”, it is important to recognize that industry currently sees the university as difficult to work with. An executive at a startup based on UA technology said that: *“UA needs to do a better job of setting a platform where all of these companies come together to solve joint problems. Given the push from the NSF for making science more usable, it’s likely that universities are going to have to start encouraging professors to be more focused on innovation that’s usable. Today they’re not pushed to solve company and industry problems, so they just focus on the pure science.”* An executive at a highly innovative mid- to large-sized firm headquartered in Akron noted that professors at UA are *“so smart they can’t get out of their own way. The research always stays a research project. There’s a major disconnect between universities and industry, because it’s just who they are; they’re academics, the research is their baby.”* And finally – just to demonstrate that this view held across all sizes of firms – an executive at one of Akron’s largest polymer firms with an ambitious research agenda said: *“we have to figure out the divide with UA; all these PhDs want to do is research.”*

- A final challenge is that the Akron polymer industry needs to be better networked not only within the industry, but with other entities statewide. This means that Akron’s economic development and political leaders need to understand the industry and its needs and translate those into a compelling case for support. A leader involved in previous polymer-oriented economic development initiatives explained that: *“the city and county ED folks ought to encourage the state and Team NEO to support the industry through research dollars and training programs. This industry is really big, and Akron is not the king of the hill. If you want to strengthen and support it, you need to join other [state-wide entities] and work on it together.... This industry is so foundational to the area that leadership needs to have a ‘polymer industry enhancement agenda’, including doing whatever it can to build support for the engineering and polymer schools at UA.”*
2. **Capital access:** interviewed firms generally did not point to a need for funding as a top concern. It is nevertheless listed here as the second most important intervention for two reasons. First, firms that no longer exist cannot be interviewed, so the fact that most interviewed firms have not had major trouble accessing capital does not mean that it is not a problem. Second, several innovative scale-up firms pointed to cost savings from shared services offered by UA Research Foundation as important to their competitiveness and survival, and these free services are in effect a form of capital (i.e., it allows them to not have to secure capital from other sources).
- University-affiliated startups, in particular those working on biomedical applications, reported no problems accessing capital. Some referenced Jumpstart, some received funding from federal sources, and one reported being *“able to raise money from individuals all over the country, with no problems”*. Via the UA Research Foundation’s I-Corps program, more university-affiliated startups have access to funding and coaching.
 - The story is somewhat different for firms that are focused on production, rather than developing IP. According to someone who works closely with startup and scale-up firms in the cluster, *“the pathway to market for manufacturers is longer, and more challenging... there are lots of scale-up problems.”* This person, however, noted that these problems typically don’t relate to production itself: *“generally, firms are either able to produce the quantities they need in-house, if they’re producing small amounts of super high-value products, for things like medical devices, or contract locally for things like adhesives and coatings.”* This would suggest that manufacturing-oriented firms struggle with scaleup because of other costs likely associated with the longer pathway described.
 - One small firm (on the verge of scale-up) that produces coatings for use in industrial applications helps illustrate. An executive at this firm noted that it struggles to get potential customers, which include very large multinational firms, to test its technology – *“if I had to charge them at cost, they wouldn’t do it”* – but that small amounts of funding (\$30,000) would enable them to produce prototypes and allow those large companies to test them for free. If this example is true, and representative of similar firms, then there is a lot of potential value that could be unlocked via relatively small investments or grants.
 - Numerous firms reported that the shared services that they receive via their affiliation with the UA Research Foundation are very important. These are evidently another low-cost, high-value service for startup and scale-up firms. One reported that the 20 percent stake that UARF has in the company allows them to take advantage of administrative functions like an attorney and accountant, which is

“really important because those are something that most startups fail to think about”. Another reported that “the support from UARF has been very helpful; without these I would have to use up cash and instead I can focus on getting products into the hands of customers”.

3. **Infrastructure and place-making:** the need for research infrastructure was brought up by many firms and is a key feature of many cluster efforts nationwide. The only reason that it is ranked lower than capital access is that it is more expensive and more risky (previous attempts to provide this have proved less effective than hoped, as noted below).
 - A representative of the university argued that: “Research infrastructure is absolutely key – these things are expensive. If a company wants to scale up production of a polymer concept, the facilities aren’t here. They don’t have the ability to create a 100kg batch of their product. We need to take the two to three potential growth areas and think about what is needed for those – not just from research standpoint, but from scale-up, all the way from start to end.” An executive involved in R&D at a highly innovative large firm agreed: “This is very capital-intensive. You have to be able to scale up from making enough product to fill a coke bottle, to 200 cubic-foot reactors to 10,000 cubic-foot reactors. So clearly having a ‘maker space’ for chemicals or polymers would be of value.”
 - The firm mentioned in the previous section that described a need for \$30,000 in funding to create prototypes currently works with UA, and noted that a major benefit is having access to a demonstration room that allows them to test products before creating commercial-scale batches. There are billion-dollar companies keeping an eye on what they produce in that facility and have expressed willingness to fund products that emerge.
 - The lack of affordable research space seems to be an obvious market failure with a relatively simple solution, but the fact that producing polymers means working with a lot of chemicals complicates the situation. As a representative of the university pointed out, UA used to run a pilot facility for students, “but graduate students aren’t great at manufacturing, and the solvents they’re using are very flammable, so you have to clean extensively and it’s hard to manage.” This person did, however, acknowledge that “flexible lab space would be helpful.” Another startup firm that hopes to manufacture its product locally pointed out that Bounce is not suited for manufacturers, because they don’t have control over the temperature (heat or air conditioning), and are not allowed to install generators (important because reactions have to be run overnight and can be dangerous if the power goes out). This firm said that even though it has raised close to \$500,000 from various sources, it had to temporarily lay off two employees because it could not find lab space.
4. **Research and commercialization:** It may seem odd that this topic is ranked lower than the others, given the emphasis on innovation throughout. The reason is that in the very near-term, what Akron needs more than direct investment in R&D capacity or programs (i.e., new labs, equipment, research grants, researchers) is to:

- Make better use of existing R&D capacity by helping firms define their needs and identify opportunities to collaborate as a collective unit with universities (this is the focus of “information and networks” interventions).
- Support existing R&D-oriented firms through other types of interventions, like capital and shared research space/equipment (this is the focus of the “capital availability” and “infrastructure and placemaking” sections).

However, it is almost certain that in the mid- to long-term, the region will need to invest in its R&D capacity and ability to create more high-tech startups if it is to remain competitive with regions like Upstate, Virginia, and Milwaukee.

- Several industry representatives noted that they’re being forced to rely more on external innovation, implying that firms will be more likely to contribute financially to joint R&D efforts. An executive at a large R&D-oriented firm said that: *“in years past, the polymer industry was very in-bred in terms of R&D, but now with the economics and resource-intensity, we’ll die a slow death if we stay that way. There are IP concerns [with joint R&D] that you really have to deal with, but we have to get past those concerns. The lab that Timken funds at the university – that’s a perfect example.”*
- Repeating a theme that was touched on many times in the “information and networks” section, one economic development representative who previously worked as a CTO in the polymer industry said that *“universities are weak on applied research and tend to go for big breakthroughs with big firms.”* It may take more than the “change in culture” that was raised in the “information and networks” section to address this tendency, which is likely a rational response by universities to the funding environment. It might require new funding for new programs/staff that can focus on applied research. (One model, for example, is proposed in a [new Brookings paper](#): an update to the MEP model wherein grants would be provided to fund doctoral or postdoctoral students to work through MEPs. This would enable MEPs to not just work with individual firms on one-time demand-driven solutions, but to ensure that basic research would be proactively translated to practical applications that mattered to groups of firms.)
- One area in which a “change in culture” may go a long way, however, is in the rate of startup creation by UA. An individual with very close knowledge of how UA functions noted that UA Research Foundation is helping to create about four to five startups per year that are capable of raising significant capital, up from just one per year in the recent past. But that number could go up to seven or eight startups per year *“with some stability and a clearer message from UA leadership and the deans of the engineering and polymers schools. One issue that I’ve been seeing is a lot of is that faculty aren’t sure that research should be prioritized relative to teaching/mentoring. Nobody wants to be the first in their department to create a spinoff or become a CTO to a company based on their technology. It’s all about quality and quantity of research faculty, dollar amount of research, and the overall research environment – the tone and feeling that researchers have about what’s important.”* This person also noted that the university is the best source for polymer entrepreneurship support, as Bounce is focused more on software and business-to-business technologies.

- 5. Talent development:** Talent is the fuel of any innovative cluster, so is certainly not the fifth most important factor in the polymer cluster's success – it is ranked fifth only because nearly every firm stated that finding skilled workers was not a challenge. Across the approximately 20 to 25 interviews completed for this project, only a couple of minor skills challenges were raised, at the lowest and highest ends of the skill spectrum (\$12 to \$13 per hour jobs doing basic production work at a rotational molding company the low end, and regulatory expertise for firms operating in the medical device industry at the high end). The imperative for the region when it comes to talent development, therefore, is to ensure that the education and workforce development systems continue to receive the funding and support that they currently do.

Summary

Key Interventions

Most fundamentally, Akron needs to rebuild relationship networks in the polymer cluster – between firms and between firms and universities. This is fundamental because it is not only an important intervention in itself – firms are more competitive when they are able to learn from other firms – but will also allow the region to understand how to design and deliver more tangible interventions related capital, infrastructure, R&D, and skills. The early stages of this work must center around the University of Akron, because despite its recent challenges and the frustrations that firms experience in trying to work with it, it is still clearly the glue that binds the cluster together (though that glue has weakened in recent years). Firms see it as not only a source of R&D, but also the best convener or “hub” of the cluster.

V. Implications for Structure and Funding

Note: To reiterate, this is presented as a basic illustration of the approximate scale and scope of an intervention that Akron should consider. It is only meant to help contextualize the findings above; more research, interviews, and analysis will need to be done to determine the exact structure and scope of any intervention. In particular, more research should be done regarding why past initiatives based on roughly similar findings (e.g., ABIA and some of Polymer Ohio’s ideas) did not prove successful.

The basic question that this report sought to answer was: is Akron’s polymer industry a potentially transformative opportunity – a way that Akron can gain a foothold in the “next economy”? And are there specific types of investments that economic development organizations could make in the cluster – in other words, a cluster initiative – that could enable this to occur? Or, alternatively, should Akron once and for all lay to rest the idea that the polymer cluster offers untapped potential, and set its sights on new opportunities instead?

These alternatives are illustrated more concretely below. The “status quo” option is to stay on the path laid out in Elevate Greater FAkron, and make no further investments beyond proactive BRE (treat the cluster as no different from any other somewhat high-tech, traded-sector group of firms). The strategic alternatives are to either (a) commit several million dollars to launching a full-scale cluster initiative modelled after the ones described in the Brookings paper “Rethinking Cluster Initiatives”, or (b) significantly reduce funding and attention and re-direct that towards higher-value opportunities (such as, for example, a major mid-tech training effort).

Note: the “rationale against” boxes in the below graphics are not necessarily the authors’ opinion or conclusion. Rather, they are meant to capture potential objections to any given strategic path from skeptical stakeholders, some of which may be based on the research (i.e., the industry is mostly mature) and some of which may be subjective (half-measures are ineffective, or the university needs to figure this out).

	Activities	Additional Cost/Staff	Rationale For	Rationale Against
Major upgrade: cluster initiative	Joint R&D capacity, facilities, capital, collaboration	\$2.5 million+ 3 FTEs	Global potential Most unique cluster University of Akron Core of innovative firms	Mostly mature Divided firm interests Expensive Compelling alternatives Few private-sector champions
Default: Cluster as organizing principle	Proactive BRE, connect to existing services	None (included in Elevate Akron strategy)	(In Elevate Akron)	(In Elevate Akron)
Downgrade: No Cluster Focus	Intentionally limited engagement	Minor savings (staff time to dedicate to other areas)	Ability to re-allocate resources to other priorities	Difficult, in practice, to intentionally limit engagement with polymers

Economic development organizations that do not understand what parts of the economy matter tend to default to scattershot half measures in every area that might matter. Thus, there is good reason to be skeptical of any proposal that suggests half measures, rather than clear, bold decisions between the strategic alternatives above. However, the research captured in this document unavoidably points to the fact that a half measure (or “strategic upgrade”) is in fact the best option for Akron’s polymer cluster. This is illustrated below.

Major upgrade: cluster initiative	Joint R&D capacity, facilities, capital, collaboration	\$2.5 million + 3 new FTEs	Global potential Most unique cluster University of Akron Core of innovative firms	Mostly mature Divided firm interests Expensive Compelling alternatives Few private-sector champions
	Activities	Additional Cost	Rationale For	Rationale Against
Strategic upgrade: cluster initiative	Building networks between firms and universities; testing potential for bigger cluster investments	\$750,000 + 1 new FTE	Not enough assets for a full-scale intervention; but huge value to tying together what exists	Half-measures are ineffective, university needs to figure this out and fund it
	Activities	Additional Cost/Staff	Rationale For	Rationale Against
Default: Cluster as organizing principle	Proactive BRE, connect to existing services	None (included in Elevate Akron strategy)	(In Elevate Akron)	(In Elevate Akron)
Downgrade: No Cluster Focus	Intentionally limited engagement	Minor savings (staff time to dedicate to other areas)	Ability to re-allocate resources to other priorities	Difficult, in practice, to intentionally limit engagement with polymers

The reason relates to the “summary” box on page 31 as well as the discussion on pages 15-19. Cluster initiatives are based on the idea that helping a certain number of firms directly will help a much greater number of firms indirectly, because clusters are defined by dense, active networks among firms that will naturally spread the benefits of investments in the “innovative core” throughout the rest of the cluster. But the knowledge networks in Akron’s polymer cluster are neither dense nor active; they are dormant. So, investing in rebuilding those networks (i.e., building an “ecosystem”) is not only an important intervention in its own right – it also will (a) reveal what other interventions might be necessary (because firms will define their shared problems via the discussions that take place in this ecosystem) and (b) ensure that if those interventions are carried out, the benefits will seep out beyond the direct beneficiaries.

What does this imply in terms of structuring and funding in the near term? The Chamber, as the lead on the Elevate Greater Akron tactics of “unify, connect, and coordinate” and “catalyze transformative initiatives”, should hire a person to manage this process for a three-year period.

- **Profile:** This person would be similar to the VP of Economic Opportunity; overseeing a specific, highly external project and reporting to Brynn. As noted, they would need to be comfortable working with firms (in partnership with the polymers BRE lead), with data and research (in partnership with the Chamber research lead), and with the university (as an outside counterpart to people like Elyse Ball at UARF). Finding a person with enough knowledge about universities, research, and technology transfer will be the biggest challenge.
- **Function:** They should get to know every one of the 25 to 40 firms at the cluster’s innovative core, as well as every important individual at the relevant departments at UA, Kent State, and Case Western (including the technology transfer offices). They should then begin formally convening firms to better

understand their needs, connect them with other firms, and figure out why frictions exist between firms and universities (despite a desire on both sides to collaborate more). These convenings must not be duplicative of other efforts, and each must have a specific purpose and be professionally managed.

- **Pilots:** While the above will help shed light on more tangible investments, this person should also launch a few pilot projects in the near term that are clearly promising based on the research in this document. That will provide an opportunity to experiment with some basic concepts before firms have decided specifically what they need. These pilot projects should likely focus on capital (a small fund to enable firms, especially manufacturers, to create prototypes for testing in clients' facilities), expanding shared services currently offered to UARF clients, and developing/expanding shared research/manufacturing space for small to mid-sized firms.
- **Cost:** The cost of this staff person would be about \$350,000 over three years, and the cost of the pilot projects would be about \$400,000, for a total of \$750,000. If this staff person were a good grant writer, and/or if initial pilots proved successful, this amount could easily be doubled through outside grants.

VI. Data Appendix

Chart: Export Totals and Growth

Polymers Exports, Akron and Peer Markets						
Metro Area	RANKED BY: Total, 2017 (\$, millions)	Rank	Total Growth 2003-17 (\$, millions)	Rank	Percentage Growth 2003- 17	Rank
<i>Cle-Akr Combined</i>	1461		368			
Charlotte, NC-SC	1067	1	346	1	48.0%	4
Detroit, MI	1042	2	88	6	9.2%	11
Cleveland, OH	891	3	285	2	47.0%	5
Greenville, SC	773	4	33	9	4.5%	12
Greensboro, NC	690	5	93	5	15.5%	9
Akron, OH	570	6	83	7	17.1%	8
Grand Rapids, MI	443	7	158	3	55.3%	2
Nashville, TN	437	8	144	4	49.0%	3
Louisville, KY-IN	379	9	-25	13	-6.2%	13
Milwaukee, WI	225	10	19	12	9.2%	10
Knoxville, TN	163	11	33	10	25.1%	7
Dayton, OH	159	12	-46	14	-22.5%	14
Toledo, OH	131	13	-92	15	-41.1%	15
Birmingham, AL	127	14	59	8	87.2%	1
Madison, WI	106	15	25	11	30.7%	6

Chart: Export Specialization and Change

Polymers Exports, Akron and Peer Markets			
Metro Area	RANKED BY: Share of All Exports, 2017	Share of All Exports, 2003	Percentage Point Change, 2003-17
Akron, OH	13%	15%	-2%
Greenville, SC	13%	13%	0%
Greensboro, NC	10%	12%	-2%
Cleveland, OH	6%	5%	1%
Charlotte, NC-SC	6%	7%	-1%
Grand Rapids, MI	5%	4%	1%
Louisville, KY-IN	4%	7%	-3%
Nashville, TN	4%	4%	0%
Knoxville, TN	4%	3%	0%
Dayton, OH	3%	5%	-1%
Birmingham, AL	3%	3%	0%
Detroit, MI	3%	3%	0%
Toledo, OH	3%	6%	-3%
Madison, WI	3%	3%	-1%
Milwaukee, WI	2%	2%	0%

Chart: Top Akron Patent Technologies

Top 15 Technology Subclasses for Patents, Akron, 2007-2011					
Technology subclass	Patents granted in subclass	Subclass share of total MSA Patents granted	Location quotient (MSA subclass patents share of all US subclass patents/all MSA patents share of all US patents)	Average subclass claims per patent (measure of patent quality)	Share of subclass patents granted to universities
Transportation	798	15.7%	7.4	4.6	0.0%
Resins	612	12.0%	6.1	21.2	3.4%
Miscellaneous-Mechanical	386	7.6%	8.5	23.2	0.0%
Communications	253	5.0%	0.5	22.9	0.0%
Receptacles	245	4.8%	3.1	6.4	0.0%
Material Processing & Handling	190	3.7%	2.4	14.5	1.6%
Measuring & Testing	188	3.7%	1.4	16.4	9.0%
Computer Software	174	3.4%	0.4	22.1	1.7%
Cleaning Chemical Products & Apparatus	136	2.7%	2.4	18.1	1.5%
Chemical-General Compounds	131	2.6%	2.2	15.0	5.3%
Electrical Lighting	125	2.5%	1.8	19.1	0.0%
Computer Hardware & Peripherals	116	2.3%	0.3	29.8	2.6%
Furniture, House Fixtures & Appliances	113	2.2%	1.5	8.5	0.0%
Miscellaneous-Other	105	2.1%	1.4	17.9	4.8%
Surgery & Medical Instruments	97	1.9%	0.4	11.8	1.0%

Chart: Total Resins Patents

Resins Patents, Top 20 Markets, 2007-2011				
Metro Area	RANKED BY: Resins patents granted	MSA share of total US resins patents granted in polymers	Resins share of MSA patents granted	Location quotient (MSA resins patents share of all US resins patents/all MSA patents share of all US patents)
SAN FRANCISCO	3,467	13.3%	3.9%	2.0
HOUSTON	2,024	7.8%	7.8%	4.0
PHILADELPHIA	1,703	6.5%	5.7%	2.9
NEW YORK	1,522	5.8%	1.8%	0.9
BOSTON	1,314	5.0%	2.3%	1.2
MINNEAPOLIS-ST. PAUL	948	3.6%	2.4%	1.2
CLE-AKR COMBINED	940	3.6%		
LOS ANGELES-LONG BEA	801	3.1%	1.3%	0.7
SAN DIEGO	778	3.0%	2.0%	1.0
SAN JOSE	698	2.7%	0.6%	0.3
WASHINGTON	697	2.7%	3.3%	1.7
SEATTLE	664	2.5%	1.0%	0.5
AKRON	612	2.3%	12.0%	6.1
PITTSBURGH	599	2.3%	6.2%	3.2
ALBANY	575	2.2%	5.6%	2.9
CHICAGO	547	2.1%	1.3%	0.6
KINGSPORT, TN	474	1.8%	37.5%	19.1
CLEVELAND	328	1.3%	3.2%	1.6
DETROIT	326	1.2%	1.1%	0.6
ROCHESTER, NY	325	1.2%	2.0%	1.0
CINCINNATI	323	1.2%	2.3%	1.2

V. Interview List

Firms

21 MedTech

Akron Ascent Innovations LLC

Akron Polymer Systems

APV Engineered Coatings

ASTI - Akron Surface Technologies Inc

Bridgestone Americas

Contitech North America Inc

Ferriot

Goodyear

K-Medical (PolyMedTech)

NextStep Arthropedix

Poly Lux

Surendra

Vadxx Energy

Institutions

University of Akron (Dr. Ali Dhinojwala)

Team NEO (Paul Boulter)

UARF (Elyse Ball)

Case Western (Dr. David Schiraldi)

Kent State (Dr. John West)

Individuals

Tom Waltermire