

Future Industry Cluster Design Methodology

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Executive Summary: Although there is considerable research that supports the characterization and strengthening of existing regional economic clusters, considerably less has focused on identifying presently latent, but potentially impactful future regional clusters. This paper will contribute to that outcome by introducing a design process, and high-level screening and reformulation frameworks, to aid in this effort. This work is built upon and extends the research on the qualitative assessment frameworks developed for individual businesses to regional clusters. The qualitative frameworks described in this paper both assess proposed future clusters and inform their reformulation. The frameworks are factors-centric and therefore represent but a subset of Porter's Diamond cluster assessment. The approach provided in this paper is not meant to replace the current methods and tools developed for assessing current regional economic clusters. Instead, the approach and tools provided in this paper are focused on helping economic developers take the first steps in creating the next robust industry cluster in their region through the application of a cluster design process. The paper advocates that universities are well-positioned to assist in the design of future regional clusters as the process plays to their strengths of being both future-oriented and objective.

I. Introduction

Economic development agencies face a number of challenges, both strategic and tactical, in the pursuit of strengthening their regional economies. The primary approaches to strengthening a regional economy can generally be categorized as business attraction, business retention and growth, and new business formation (entrepreneurship). While the focal point of each of the three major approaches is quite different, common to each approach is the focus on the individual company versus a holistic view of the regional economic system. While each firm in the region certainly contributes to the overall regional economic vitality, it is the economic viability of the collective whole that defines the region's robustness. Given the goal is strengthening the regional economy, it should ideally follow that the strategy of regional economic development be aimed at increasing the health of the regional economic system.

Universities, in educating the next generation of leaders, scientists and policy makers, have always been an integral part of economic development. These institutions' role in economic development, however, continues to increase. Vannevar Bush (1945) advocated for the expansion of government-funded university research from an economic development perspective. The Bayh-Dole Act (Bayh & Dole, 1980) placed direct responsibility for the commercialization of government-funded research onto universities. Universities responded to that act with technology transfer offices, entrepreneurship education, business accelerators and incubators, and policy advisement (Solomon, Duffy, & Tarabishy, 2002; Yusuf & Nabeshima, 2007). In 2007, the Association of Public and Land-grant Universities (APLU) created a commission dedicated to economic development (CICEP – Commission on Innovation, Commercialization and Economic Prosperity) (APLU, 2015).

Industry clusters are geographic aggregations of interconnected businesses and associated institutions. Taking a cluster perspective of one's regional economy does not replace the three general approaches to economic development (company attraction, business retention/growth, and new business formation); it assures their operational coordination by providing an overarching strategic perspective to regional growth. The three general economic development approaches should be looked upon as potential operational approaches (by themselves or in combination) to enable the cluster-based regional growth strategy. Ideally the priority of a region's limited resources would be targeted at firms that will build, support, or grow the regions advantaged cluster's strengths. Firms that both align with and reinforce the region's economic strengths have a greater and more lasting impact on the regional economy than firms that do not do so (Porter, 1990). As a result, rather than approaching economic development at a series of one-off projects, the cluster approach allows for a strategic, systems approach the regional economic development.

Unfortunately, tending to a region's current economic clusters is not enough. Economic developers in the Midwest United States that had their manufacturing base move elsewhere, or those in Finland trying to determine what will drive their economy in a post-Nokia world (Sally, 2015) understand that regional economies can quickly change. This requires that, in addition to tending to their current economies, developers need to envision and nurture currently latent economic clusters in their regions. Before these future clusters can be developed, however, they need to be designed.

Not every economic cluster has an equal probability of being successful in every region. Successful clusters are built upon the region's unique combination of economic factors. This paper contributes to the early-stage design of future regional economies by introducing high-level tools that will allow the economic developer to screen and improve rough concepts for new regional economic clusters without investing an enormous amount of time or resources on detailed regional studies. An early-stage screening and reformulating mechanism will provide the opportunity to explore a wide array of regional options before investing in the detailed assessment of a few.

Regional economic cluster design fits well with universities' future orientation. Universities are the most aware of the skills future graduates will command and of emerging new technologies that are largely being developed at their institutions. In addition, these institutions can often be more objective in their findings than government agencies as they tend to be more detached from regional

politics. All of these factors contribute to the objectivity of the design of new regional economic clusters.

II. Background

Economic developers typically focus on identifying and strengthening existing regional economic clusters. There are an increasing number of tools to help economic developers perform this work (Nolan, 2010; Nolan, Morrison, Kumar, Galloway, & Cordes, 2011, US EDA, 2015). Those tools certainly strengthen the economic developers' capacity to assess and strengthen current regional economic clusters. This paper is focused on aiding the economic developer discover latent regional economic clusters. Economic developers not only need to understand and strengthen what is presently in their regions, they also need to be able to identify what is currently not there, but could be. This is a design challenge.

Whether you are creating a new product, a new business, or a new economic cluster, it begins with the design. Design has three interconnected actions: diagnose, propose, and evaluate. The proposed design is increasingly refined as knowledge is attained and the postulated construct tested. A good design process works on many levels; it both assesses proposed constructs and provides insight to their improvement. Design is also an iterative process, as propositions are refined from pure speculation to conjecture to abductively-reasoned conclusions through increasingly detailed information gathering and assessment.

This paper contributes to the early-stage design of economic clusters by developing high-level, qualitative tools that allow the economic developer to assess and reformulate concepts for new regional economic clusters without the need to invest enormous amounts of time or resources on detailed regional studies. Having an early-stage design process will allow the economic developer to explore a wide array of options, before investing in the detailed assessment of a few. This work broadens the previous work on occupational clusters (Nolan, 2010; Nolan, et al, 2011; US EDA 2015) by taking into account a range of regional factors that impact cluster development. The paper extends the previous research that created and validated qualitative frameworks for the creation and repositioning of individual businesses or lines of businesses within larger corporations (Adriaens & Faley, 2011; "Success," 2012; Tahvanainen, 2014; Faley, 2015). The intent of this paper is not to review the business-level assessment frameworks that have already been developed, but rather to demonstrate how to extend them for qualitative cluster-level assessment.

Change-Process Design

In approaching any new aspiration, the first step is to create a specific objective you believe will move you toward that aspiration. This is an inductive versus deductive process. You start with the answer (typically a proposed activity), but must check to see if that activity will actually drive you toward your original aspiration before proceeding with its implementation. Three critical questions need to be addressed in transforming this objective into a truly SMART (Specific, Measurable, Achievable, Relevant, Time-bound) objective. The first major question that must be addressed relative to the objective is “can I do this?” “Do I have the capabilities necessary to realize this activity?” If not, what am I missing and how can I acquire those capabilities?

Say that I aspire to lose 10 pounds. I conjecture that eating healthier would be helpful. Eating healthier becomes the objective. However, in order to eat healthier, I may realize that I need to consult with a dietitian to enable that activity as my current food knowledge is inadequate to realize that objective on my own. In other words, I lack the capabilities necessary to implement the objective without acquiring new capabilities through a partnership with a dietitian.

The second major question that must be addressed is “will realizing the objective create a material change in the current condition I desire?” In other words, will the realization create sufficient impact to justify the effort to accomplish it? Will eating better, in this example, help me lose the ten extra pounds (my original aspiration)? Maybe, but maybe not. If not, how do I reshape the objective in order to make a more significant impact on the larger aspiration?

The third and final question that needs addressing “is achieving the objective plausible?” That is to say, what is the feasibility or likelihood of implementing the change? There are both intrinsic and extrinsic conditions that come into play here. Am I motivated enough or have the resources available to consult a dietitian? If not then I need to revise the objective, but in a manner that is still aligned with the aspiration. I could, for example, keep my diet the same, but instead decide to walk every morning.

The analysis would then need to be repeated: Am I capable of doing this? Will it have the desired impact? Do my current conditions provide a fair chance of successfully implementing the objective? If not I may have to again reset the objective or change the overall aspiration. Material changes only occur when all three questions can be positively answered.

The same general approach applies to individual businesses. The achievability question in business is “can

the proposed firm compete?” Can it compete at all, in a narrow niche market, or globally? The “impact” question for a business addresses its growth potential. Is the proposed new firm potentially a lifestyle business or one that can significantly grow? The final question is one of feasibility (Faley, 2015).

The goal is to be able to quickly screen and then reshape or discard many scenarios before diving deep into a detailed assessment of one. The process therefore requires that each of these three overarching assessment questions be performed on multiple levels. The first level is a qualitative or screening level that provides insight to the refinement/improvement of the original hypothesis. The second level, if warranted, is a more detailed, quantitative analysis. This qualitative-to-quantitative progression allows one to “fail fast” by allowing multiple approaches and ideas to be quickly screened/reformulated before delving deeply into the analysis one a single concept. Entrepreneurs have the tendency of falling increasingly in love with a concept the longer they work on it. Once they spend an enormous amount of time performing a detailed quantitative assessment of a potential new business, they will find a way to convince themselves it will work. The way to avoid this trap is to screen and reposition ideas with a minimal amount of effort and time. Hence the need for a relatively quick qualitative-focused design step before performing a detailed quantitative assessment.

This paper further extends the general concept of using qualitative assessment frameworks from individual businesses to regional clusters. The design process for economic clusters is multi-level, as illustrated by Figure 1. Once an initial cluster-level design has been created, the process moves one step inward to the company-level. This is due to the fact that the ultimate cluster strategy will need to be operationalized at the company level by determining which firms, or types of firms, should be recruited or incented to grow or aided to start. This is analogous to the dependence of the success of a company-level strategy on the inner capabilities of the firm.

This approach is also iterative in that a negative assessment at an inner level will require one to return to the next outer layer and iterate on the design at that level. The ability to perform quick screens on many potential future regional economic clusters is therefore dependent on having high-level screening/repositioning tools at each level of the overall analysis. This paper describes qualitative assessment/repositioning tools for use at the cluster level.

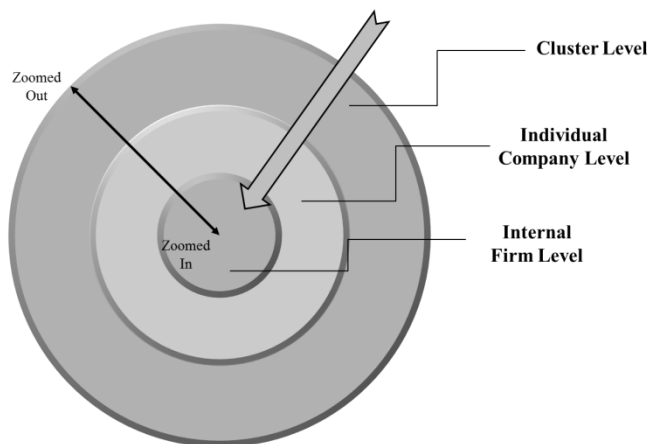


Figure 1: Layered approach to regional cluster design

Economic Clusters

A cluster-centric approach to economic development has two parts: “Traded Clusters” which serve markets beyond the region, and “Local Clusters” which serve regional markets (Porter, 1990). Traded Clusters have been shown to have a significantly larger impact on local economies in terms of the creation of high-paying jobs, etc. (Porter, 2003). The two are clearly related, as Local Clusters will also serve the firms of the regionally-located “Traded Cluster.” But as Porter said, there should be no doubt which drives the local economy. In a talk given in September of 2014, Porter said, “The Traded Cluster is the dog, and the Local Cluster is the tail.” (Porter, 2014). While Local Clusters certainly add to the overall robustness of the regional economy, it is the Traded Cluster that drives the region’s economic success.

An established approach of assessing regional economic stability and growth has been the identification and development of these industry clusters. The impact of industry clusters was clearly laid out in Michael E. Porter’s 1990 book *The Competitive Advantage of Nations* (Porter, 1990). The industry-cluster concept, however, dates back to English economist Alfred Marshall’s 1890 book *Principles of Economics* (Marshall, 1890). Porter proposed that “Nations are most likely to succeed in industries or industry segments where the national “diamond” is the most favorable.” (Porter, 1990, p. 72). Porter’s Diamond, shown in Figure 2, describes the primary determinants of the national (or regional) economic system.

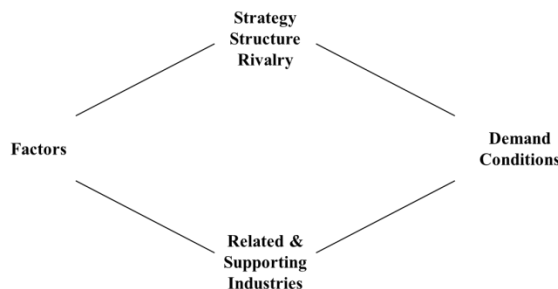


Figure 2: Porter’s Diamond

The four interrelated components of Porter’s diamond include 1. Factors, 2. Strategy, Structure and Rivalry, 3. Demand Conditions, and 4. Related and Supporting Industries. Each will be subsequently described.

Factors

Factors are what economists refer to as “factors of production” which can be classified in five broad categories. These factors can be “basic” or “advanced” depending on their degree of specialization. A region can also have “disadvantaged” factors, or a lack of basic factors (ex. reliable electrical system). The five broad factor categories include: Human Resources, Physical Resources, Knowledge Resources, Capital Resources, and Infrastructure. Infrastructure can range from transportation systems to quality of life affecters.

Strategy, Structure and Rivalry

The second component of Porter’s Diamond is strategy, structure and rivalry. This component includes the firm’s aspiration. Do they have global intent or are they satisfied serving the local market? This component also addresses the rivalry among the firms. Firms that leverage similar factors can be rivalrous, if serving the same market, or complementary if serving different markets. A healthy mix of both, according to Porter, spurs innovation and growth. Combining this with the factors component reflects how the region can compete globally.

Demand Conditions

The third component of the diamond is demand conditions. This component addresses the region’s ability to access the demand, which may be local and/or global. Combining this with the region’s factors position reflects how the region’s supply potential aligns with the total demand.

Related and Supporting Industries

This final component of Porter’s Diamond addresses the entire local system. It provides insights as to the degree the firms and associated institutions are complementary. This component, combined with the factors component, yields insight as to the conduciveness of the local

environment to support a specific industry cluster. This will be discussed in greater detail later in this paper.

Although there is considerable research that describes the identification and evaluation of specific existing regional economic clusters (e.g., Delgado, Porter, & Stern, 2003; Porter, 2003; Rodrik, 2010), there has been less discussion on how to systematically go about assembling regional clusters in the first place. The work on occupational clusters (Nolan, 2010; Nolan, et al; 2011, US EDA; 2015) is certainly a significant step in that direction. The pragmatic challenge for economic development agencies, however, is that taking a broader perspective of their region and evaluating all of the components of the diamond would require a significant investment as the components are idiosyncratic and, as a result, are both expensive and time-consuming to create. This paper proposes a solution to that challenge by offering high-level, qualitative cluster-design frameworks that address the breadth of Porter's Diamond components; frameworks that complement and can be used in association with previously-developed company-level design frameworks thereby creating a practical means of enabling the design process illustrated in Figure 1.

In the layered design approach proposed here, and illustrated in Figure 1, two distinct, but interrelated assessments must take place in order to design a successful cluster. One is a cluster-level analysis where the overall ecosystem is assessed. The second is a company-level assessment where the potential of the individual firm is assessed. The two are interconnected in that the location and relationship strengths of being a member of a regional cluster will aid in the success of the individual company, which will, in turn, strengthen that cluster. The intent of this paper is not to review the frameworks that have already been developed for company-level assessments, which will be necessary to complete the overall process illustrated in Figure 1. Rather this paper will serve to introduce and describe the cluster-level design-assessment frameworks.

Cluster-level Design-assessment Frameworks

Design-assessment frameworks need to accomplish more than testing the viability of a proposed construct. The frameworks also need to provide actionable insight that can be used to refine or reformulate that construct. The frameworks described in this paper accomplish both, despite being referred to as "assessment" frameworks.

The frameworks follow the same approach as described in the change-process design section. For personal change the critical questions are 1. Under what conditions is it doable? 2. Is it impactful? and 3. Is it plausible? These general questions are framed in slightly different ways, as previously discussed, depending on whether the proposed

change is a personal-level or business-level one. For businesses, the questions were framed from a capabilities-centric perspective. They are 1. Can the proposed business compete? 2. What is its potential for growth? And 3. Is the business feasible? For economic clusters, the questions will be framed from a factors-centric perspective.

Given that this approach to cluster development takes a factors-centric perspective, a complete Porter Diamond assessment is not performed; the evaluation is limited to those elements that are directly connected to the factors, as shown below. When viewed through the lens of the Porter's Diamond, as illustrated in Figure 3, the three generic questions are: 1. Can the regional cluster, if created, compete? 2. What would be the cluster's impact in terms of balancing supply and demand? and 3. Is creating this cluster plausible, or in other words, is the local business environment conducive to its formation?

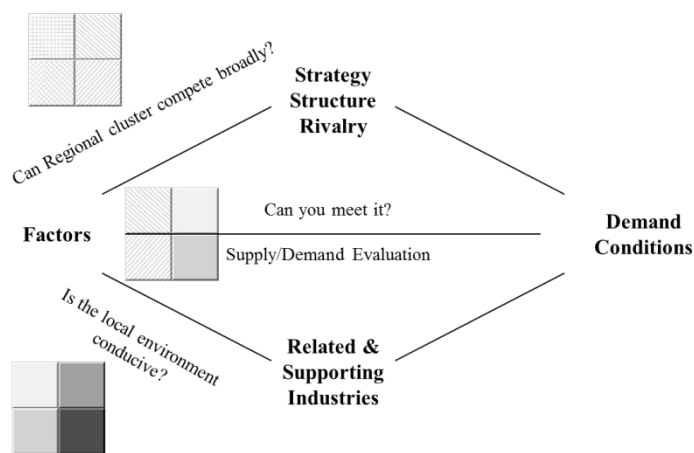


Figure 3: *Annotated Porter's Diamond*

The cluster-level design-assessment frameworks will each be described in detail in the next three sections. The cluster factors-centric frameworks are analogous to the capabilities-centric frameworks of individual firms. No environment is entirely self-contained, all leverage the greater ecosystem. Every business leverages capabilities of the greater ecosystem, beyond its internal capabilities, in the creation and delivery of its products to its customers. The capabilities a firm leverages beyond its borders, which could range from product design to component manufacturing to shipping, are known as "complimentary capabilities." So too does every region leverage economic factors beyond their region. The factors that are leveraged beyond the regional ecosystem are deemed "complimentary cluster factors." The cluster-level design-assessment frameworks evaluate the differentiable factors

a region may have versus those it will leverage from the greater ecosystem.

The first framework, as will be discussed in the next section, assesses the local cluster factors versus those complimentary factors. The second framework assesses the impact potential of the regional cluster after the hypothetical incorporation of any new potential firms that may have been identified as needed as a consequence of the first framework assessment. It combines the “Demand” component of Porter’s Diamond and balances it with the supply capability of the regional cluster. The final framework assesses the plausibility that the new regional cluster could be formed. This framework assesses the likelihood that the new elements or firms can be successfully incorporated into the region. Each framework will be discussed in detail. Make no mistake, using these high-level design-assessment frameworks is not a substitute for a full-blown Porter Diamond analysis of a regional cluster. The frameworks only provide a qualitative, factors-centric subset of the diamond allowing economic developers the ability to quickly screen and refine future regional cluster designs.

III. Cluster Competitiveness Potential

The Cluster Competitiveness Potential framework, Figure 4, is used to provide a qualitative, high-level assessment of the proposed cluster’s strength. This framework assesses the local cluster factors versus those complimentary factors that the region will need to leverage. As a design tool, the framework provides insights as to what is missing from the current regional business ecosystem given the aspiration of creating this new regional economic cluster. The horizontal and vertical axis represent two independent variables. The region’s position is derived from determining its relative position on both axes.

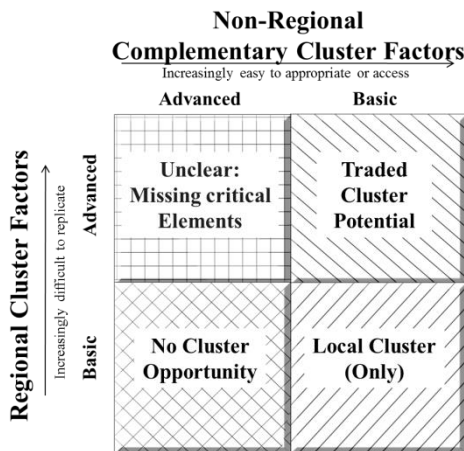


Figure 4: Cluster Competitiveness Potential

A business’ competitive position is dependent on the strength of its capabilities relative to its competition.

Similarly, a region’s competitive cluster position is based on the strength of its regional factors versus that of other regions. Basic factors are those, relevant to the economic cluster being assessed, that are readily available and common to most economic regions. They include basic infrastructure (transportation, water, power, broadband), unskilled and semi-skilled labor, and other factors necessary to do business. Advanced factors are those that would be difficult (either expensive or time-consuming or both) or impossible (eg. a rare natural resource) for other regions to replicate. These factors, again relative to the economic cluster being assessed, could include availability of highly-skilled (often STEM-educated) workers, quality of life, or specialized natural resources such as oil shale reserves. CNBC recently used workforce talent and readiness as the top criteria for ranking business climates (Cohn, 2015). The framework provided here assesses all regional economic factors.

Being in the upper-right quadrant of Figure 4, suggests that the region has advantaged regional factors, relative to the cluster being evaluated, while only requiring basic factors from the broader (non-regional) business ecosystem. Houston, Texas in the oil and gas cluster would be a prime example of a region in this quadrant. The region has advanced infrastructure and knowhow with respect to oil and gas processing and distribution.

Regions that have advantaged factors, but are missing essential basic factors that cannot be readily imported to the region would fall in the upper left-hand quadrant of Figure 4. A region may, for example, be proposing a server farm based on its enormous band-width access, but lack the basic infrastructure (reliable utilities) needed (Barber, 2015). The upper-left hand quadrant of Figure 4 illustrates how only having some advanced factors is insufficient. This quadrant, while labeled “unclear” holds the potential for regional exploitation by outsiders for those that find themselves here. The resource-rich, but economically-challenged sub-Saharan African region is a constant reminder of this paradox. Foreign Direct Investment (FDI), or its regional equivalent, is not enough to shift the position to the upper right-hand quadrant if the complementary advanced factors are not integrated into the fabric of the region.

Proposed cluster designs that fall in the lower two quadrants of the Cluster Competitiveness Potential framework (Figure 4) need to be altered if they are to have Traded Cluster potential. Those with basic factors and only needing basic factors from the greater ecosystem (lower right-hand quadrant) have the potential to be a Local Cluster, but cannot transcend to a globally-competitive Traded Cluster without first enhancing their factors. Like niche businesses, these Local Clusters can be quite

successful regionally by serving local demand and/or regional traded clusters. They simply do not have the factor strength to compete globally. This is the assessment aspect of the framework. Using the framework as a cluster design tool, the question for the regional developer is could these needed advanced factors be developed regionally? Could firms be attracted to the region or created in the region that would have or develop these factors? From a design perspective, it is about how to creatively reformulate the original cluster in order to reposition it into the upper right-hand quadrant of Figure 4.

Universities can play a significant role in the repositioning a potential cluster into the upper right-hand quadrant of Figure 4 by strengthening and differentiating the region’s factors. The university’s traditional economic development role in workforce development applies here. University can develop programs to develop the missing workforce elements; whether that be increasing the number of engineering graduates or producing students with a strong background in a niche area of equity finance.

Beyond workforce development, universities can also strengthen a region’s factors by leveraging their research. Research results can be licensed to existing firms in the region to strengthen their global competitiveness or be used to create local university spin-outs that would add an exciting innovative component to the proposed new cluster. A university can also strengthen the region’s factors by establishing a reputation as a “center of excellence” in the foundational area of the proposed new industry cluster. This can be achieved by assisting faculty with grant-writing and publications, both in academic and industry-serving journals, which target the factors the region would like to strengthen, such as nanotechnology or advanced manufacturing.

The final quadrant of the framework is the lower-left, “no cluster opportunity” quadrant. Unlike those in the lower-right quadrant, those that fall in the lower-left region need significantly more factors than the region can contribute to the success of the cluster being considered. Clusters that fall in this quadrant are not viable and should be eliminated from consideration.

As previously noted, once a potential cluster’s current place on Figure 4 is established, strategies need to be created to attain the resources necessary through development, growth, or acquisition, to reposition the cluster to the upper right-hand quadrant. Once the new aspired-to cluster for the region is crafted, based on filling in the missing elements necessary to reposition the regional economy to a more desirable quadrant, policies or other specific operational tactics, such as those previously mentioned, will need to be put in place in order to realize

the vision. However, before, this operational step occurs, more assessment of the re-positioned regional cluster design is necessary. The second two frameworks (Figures 5 and 6) are implemented from a future state—after the original cluster design has been hypothetically repositioned but before any effort (including policy development) is undertaken to implement this repositioning. The concept is to make sure the cluster design changes proposed via insights obtained from Figure 4 are worthwhile, as determined via the frameworks illustrated in Figures 5 and 6, before any implementation effort begins. The cluster design should be completed, including positive feedback from all three frameworks (the proposed new cluster can compete, its creation is regionally impactful, and it is plausible), before moving forward to perform more rigorous assessments and certainly before the moving on to the project’s execution phase.

IV. Cluster Impact Potential

The second framework, the Cluster Impact Potential framework, Figure 5, assesses the impact potential of the proposed regional cluster. This framework combines the “Demand” component of Porter’s Diamond and balances it with the supply capability of the proposed regional cluster. This framework assessment takes place after the hypothetical incorporation of any new potential firms that may have been identified as “missing” as a consequence of the first framework assessment (Figure 4). If, for example, the original cluster design fell into the lower right-hand quadrant of Figure 4, then a strategy would have to be devised that would move that designed cluster to the upper right-hand quadrant before moving on to the Impact Potential framework. If attracting Exxon-Mobil to the region could move the potential cluster to the “Traded Cluster Potential” quadrant of Figure 4, then the question Figure 5 asks is ‘would it be worth doing?’

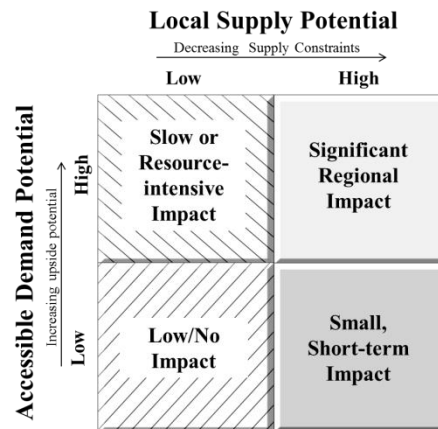


Figure 5: Cluster Impact Potential

When implementing any change, one would prefer to know the impact of that change before investing the resources necessary to implement that change. The prior assessment (Figure 4) provided the economic developer with the competitiveness of their designed future cluster and informed them as to its repositioning. Although the framework informed a pathway to repositioning, it did not evaluate the local impact of that repositioning. Figure 5, the Cluster Impact Potential framework, provides insight regarding the impact of the proposed new cluster on the region, which after all, is the key driver for economic developers. Like all of the frameworks presented in this paper, this one does so from a factors-centric perspective.

The Cluster Impact Potential framework assesses the demand conditions; the demand that is accessible by the region. This does not mean that it is solely a local demand. Certainly, as Porter argued, local demand makes it easier for regional firms to refine their offering through iterative product development. However, in an increasingly flat world it is the demand that is readily accessible by the region, not necessarily the local demand, that matters. There are certainly constraints that would prevent a region from accessing demand beyond their location. These constraints range from policy (embargos of Cuban-based products to the US, for example), to physical constraints (no current infrastructure exists to allow the transmission of excess electricity in Puerto Rico to reach its neighboring islands), to relationship-based constraints (regional firms have no connection to and/or knowledge of markets beyond their boundaries). Clearly increasing accessible demand increases the region's economic upside potential. Demand, however, is only half of the challenge.

The horizontal axis of the Cluster Impact Potential framework (Figure 5) addresses the other half of the challenge – the regional supply potential. There will be regional supply constraints. These constraints will range from infrastructure (available sites, utilities, water, transportation) to capital, both human (appropriate workforce) and financial (availability of investment capital). The lower the relevant constraints for a particular economic cluster, the greater the region's chance to increase supply as accessible demand increases. An inability to meet demand will invite other suppliers, thereby increasing the competition in the space. It will therefore be difficult for any regional cluster that finds itself on the left-hand side of Figure 5 to globally dominate, as the space will become very competitive as new entrants enter to fill the unmet demand and then compete for market share. In addition, although the accessible demand is potentially high, regional clusters in the upper left-hand quadrant of Figure 5 will find their growth slowed both by the

competitive nature of the space, and predominately, by the resource-intensity that growth will require.

The regional economic cluster designs that will have the greatest future impact on the regional economy are those located in the upper right-hand quadrant of the Cluster Impact Potential framework. Potential clusters in this quadrant will be able to access a significant demand and will be able to grow regionally, due to low supply constraints, in order to meet that demand. However, if the region is not competitive (as determined by Figure 4), it does not matter if the demand is high and the region could theoretically meet it. This is the interdependence of Figures 4 and 5. The objective is to fashion a regional cluster that is both globally competitive and regionally impactful. The qualitative nature of the frameworks allows for rapid prototyping of regional cluster designs that will meet both objectives.

Universities can play a multi-faceted role in repositioning a region with respect to the Cluster Impact Potential. In addition to the university's ability to significantly impact the workforce development, as described in the previous section, the university can also play an important role in both increasing the region's accessible demand potential and its local supply potential. Universities, for example, can take the lead in building relationships with other locations beyond the region. These relationships are the foundation to accessing those non-regional markets. It is often easier for a university to lead this relationship-building as they are not directly involved in the competitive nature of the businesses of the regional cluster. This relationship-building can take the form of a research project or a student experiential learning program. Whatever the form, the knowledge obtained from the external region can be shared with and leveraged by local businesses.

Universities can also impact the Local Supply Potential by working with the regional governments to create policies that would be advantageous to the proposed cluster. Universities can provide the role of the neutral, non-political, thoughtful, data-driven policy creator that may be necessary to overcome regional political gridlock.

V. Cluster Formation Plausibility

The final design check for a new or emerging regional cluster is Cluster Formation Plausibility, as illustrated in Figure 6. While it is necessary that a cluster be both competitive and regionally impactful, those criteria alone are not sufficient. The creation of such an economic cluster must also be plausible, that is to say its creation must be feasible. Consistent with the overall approach, the objective is to find a qualitative, high-level means to answer this question, not to partake in a time-consuming feasibility

study. The term plausible is therefore preferred over feasible as the latter implies a rigorous study.

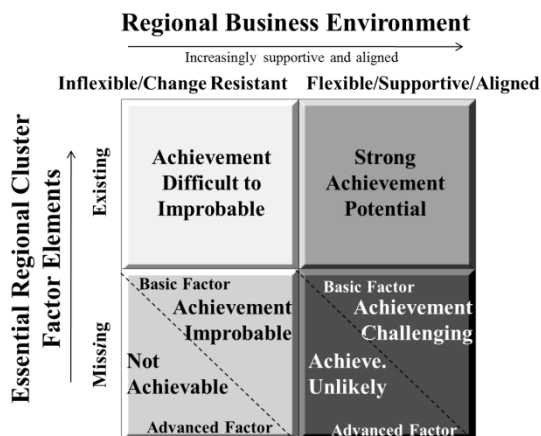


Figure 6: Cluster Formation Plausibility

The vertical axis on the Cluster Formation Plausibility framework (Figure 6) represents essential factors that the cluster needs locally in order for it to function. These factors either exist, or are missing. Existing factors include those factors that exist in the region, but may not be currently be aligned with the economic cluster being assessed. These factors would need to be repositioned toward the new cluster. That repositioning would likely require the creation of policy incentives to help speed this transition. The good news here is that the necessary factors do exist in the region. For example, the region may have tool-and-die shops making parts for the automobile sector, but it is the oil and gas cluster that is being evaluated. These shops could potentially be re-aligned to produce parts for oil and gas sector. Since we are considering future cluster designs, it is unlikely that the specific capabilities currently exists in the region, so the tool-and-die firms currently do not do so.

The region may indeed be in the upper half of the competitive framework (Figure 4), but it absolutely needs some additional local-factors in order to create a vibrant cluster in the region. This fact is not necessarily taken into account in Figure 4 (Cluster Competitiveness Impact), but is definitely assessed via Figure 6 (Cluster Formation Plausibility). For example, a significant reservoir of oil is discovered in the region, but the extraction capabilities do not currently exist locally. Similarly, the region may sit next to a significant communications trunk, but without a reliable power source the creation of a large server farm in the region is unlikely. As the examples show, these regionally-missing factors may be classified as “basic” or “advanced,” but they need to exist locally for the regional cluster to viably function.

The horizontal axis of the Formation Plausibility Framework (Figure 6) is a measure of the flexibility of the region’s business environment. The business ecosystem is, of course, also a part of the general regional environment, so that must be integrated into this measure as well. Environments on the right-side of Figure 6 are flexible and supportive. It is easy to start a firm, hire/fire employees, etc. There are also many active business organizations in the region that allow local firm employees the opportunity to network and understand each other’s business needs. A community’s time-orientation can be used as a first-order proxy for its position on this axis. Zimbardo and Boyd (2008) discuss individual’s preferred time orientation. While most people are a healthy mix of present, past, and future orientation, predominately past-oriented people are reluctant to change, while predominately future-oriented people readily embrace it. It is similarly so with communities. Some communities are predominately focused on their past. Their historical societies are very powerful and think more about preserving an existing climate than looking to create the next one. The future-oriented communities, on the other hand, realize the cheese has been moved and actively seek the next reincarnation of their region. These future-oriented communities fall in the right-side of the Plausibility framework, while the past-oriented ones would fall in the left-hand side. Balanced, or present-oriented communities would fall somewhere in the middle (all other conditions being the same).

The right-hand quadrants of Figure 6 represent regions that are business-friendly, future-oriented, and flexible. Regions in the upper right-hand quadrant also have the existing factors necessary to build the economic cluster being considered. This position does not mean that there is certainty in creating the proposed design. Some investment may be required to reposition existing factors from their current use, as previously discussed. The pace of achievement will depend to a large extent on the level of collaboration among the parties involved and upon the availability of the investment capital that may be needed.

Moving to the upper left-hand quadrant significantly decreases the plausibility of creating and/or expanding the economic cluster being considered. Even through the appropriate factors may exist, there needs to be significant collaboration to reposition them for use in the new cluster. Lack of collaboration/communication among the regional constituents severely negatively impacts the possibility of this occurring. Fixing this will require a regional culture change. Such collaboration also negatively impacts any chance of policy being created that would incent firms to reposition. For those past or present-oriented, policy that

may in the short run help one constituency group, but in the long-term help the entire region, will be likely be defeated for being “unfair.”

Regional cluster analysis that has missing essential cluster factors will have a difficult time regardless of their ecosystem. These designs fall in the bottom half of Figure 6, the Cluster Formation Plausibility framework. Obviously, those that are missing “only” basic factors and have a highly-collaborative region will fare better than most (upper portion of lower right-hand quadrant of Figure 6).

The value of the assessment is that it clearly identifies the cluster design’s challenges. The other advantage of this assessment is that it provides focus; providing economic developers a specific list of criteria for firms they are trying to attract to the region, for example. On the other hand, if those missing factors are primarily infrastructure in nature, the challenge will be on finding the financing to cover their creation.

The challenge increases for inflexible regions that are missing essential factors. The plausibility of successfully creating an economic cluster with missing elements in a region with an inflexible business environment drops further when the missing factors are advanced as opposed to basic (lower half of the lower, left-hand quadrant of Figure 6). Either way, unfortunately, the odds are not in their favor. This framework reinforces the fact that creating a vibrant economic cluster in a region will not occur without a concerted, focused effort. It is very unlikely to occur spontaneously.

Universities are well-positioned to take a leadership role in the Cluster Formation Plausibility assessment. Being politically and industry agnostic, universities are in a unique position to create a credible, long-term, holistic assessment of the regional economy that will be accepted by the region’s constituents as such. Through workforce development, technology commercialization and policy creation they can also support the transformation of the current regional economic state to the desired future one.

VI. Iterative Design Process

Recall that design has three interconnected actions: diagnose, propose, and evaluate. The first activity in the design of a future economic cluster is to assess the region’s strengths. This is the diagnosis phase. The second activity is to propose a future regional economic cluster consistent with those strengths. This proposal should include the actions the region may need to take to successfully form the hypothesized new cluster. The proposal will be coarse at the beginning, but will be continually refined as the process moves forward. The third activity is to evaluate the proposed design based on the information gathered in the diagnostic phase. Design assessment needs to do more than test the viability of the proposed design, it also needs

to provide insight on its improvement. The previously-described design-assessment frameworks accomplish both.

The design process is both iterative and inductive. It is inductive in that the proposed cluster is typically asserted first, followed by the diagnosis and evaluation actions. An alternate cluster or a refined cluster is formulated, and the process repeated until either a satisfactory design is obtained or the original premise is rejected.

The initial evaluation provides insights on the actions the region must accomplish in order to create a Traded Cluster from the conjectured one. The Cluster Competitiveness Potential framework (Figure 4) both assesses the proposed cluster and informs the actions that need to be taken for the cluster design to result in a globally-competitive Traded Cluster. The objective of this evaluation phase is to identify the “blank” in, “if we had or could develop ____ then we could move to the upper right-hand quadrant of Figure 4.”

The second evaluation step is completed only after a design has been developed that satisfies the Cluster Competitiveness Potential screen. The next two assessments are performed assuming that the actions required to move the proposed cluster to the upper right-hand quadrant of Figure 4 can be successfully implemented. The Cluster Impact Potential framework (Figure 5) tests the impact the proposed new or improved cluster would have on the region. If this impact is deemed unsatisfactory, then the cluster design is re-formulated and re-assessed via Figure 4. If the impact design test is satisfactory, then the plausibility design test (Figure 6) is implemented. If this proves unacceptable, then the cluster must be re-designed and the process repeated. The overall process is systematic as each assessment provides insight on the shortcomings of the proposed design, informing its improvement.

After each of the design tests are satisfied using this qualitative methodology – the proposed new cluster is determined to be competitive, will have regional impact, and is plausibly achievable – rigorous quantitative assessment on the optimal design will need to be performed. The qualitative assessment does not replace more thorough analysis, but allows for quick iterations of many different scenarios before the thorough analysis is undertaken.

VI. Conclusion

Industry clusters are geographic aggregation of interconnected businesses and associated institutions. Traded Clusters, which serve markets beyond the region, have been shown to have a significantly larger impact on local economies in terms of the creation of high-paying jobs, etc. (Porter, 2003). Significant effort is underway in regions to identify their existing clusters. Concurrently, the

core strategies of economic development (company attraction, business retention/growth, and new business formation) are increasingly being used to strengthen these regional clusters.

Global competition for companies requires that regional economic developers also diligently envision and nurture currently latent economies in their regions. This paper introduces a design process, and high-level screening and reformulation frameworks, to aid in this effort. The frameworks address the three main questions of change: 1. Under what conditions can the proposed new cluster compete? 2. Will the cluster, if successfully realized, create the desired regional impact? and 3. Is the cluster formation plausible, given the regions needs and business environment? All three analyses take a factor-centric perspective; factors being what economists refer to as the regions factors of production. The result is the frameworks represent a subset of Porter's Diamond cluster assessment framework, including only those elements of the diamond that are connected to the region's factors.

This work shifts the focus from existing to future cluster development. The approach provided in this paper is not meant to replace the current method for assessing current regional economic clusters. Instead, the approach and tools provided in this paper are focused on helping economic developers take the first steps in creating the next robust industry cluster in their region through the application of a high-level design process. This work builds upon the capabilities-based company development work (Faley, 2015) that was validated, in part, by research performed by ETLA, the Research Institute for the Finnish Economy (Tahvanainen, 2014). It also extends the efforts being researched on Occupational Clusters (Nolan, 2010;

Nolan, et al, 2011) by taking into account a range of regional factors that impact cluster development.

Not every economic cluster has an equal probability of being successful in every region. Successful clusters are built upon the region's unique combination of economic factors. This paper contributes to the early-stage design of future regional economies by introducing high-level tools that will allow the economic developer to screen and reposition rough concepts of new regional economic clusters without investing an enormous amount of time or resources on detailed regional studies. The early-stage screening and repositioning mechanism provides the opportunity to explore a wide array of regional options before investing in the detailed assessment of a few. Regional economic cluster design fits well with universities' future orientation. Universities are the most aware of the skills future graduates will command and of emerging new technologies. In addition, these institutions can often be more objective in their findings as they tend to be more detached from the regional politics. All of these factors contribute to the objectivity of the design of new regional economic clusters.

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