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Determining Stakeholder Perspectives Within a Local Multi-Stakeholder Collaborative Network

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DETERMINING STAKEHOLDER PERSPECTIVES WITHIN A LOCAL MULTI-STAKEHOLDER COLLABORATIVE NETWORK

By

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Abstract

DETERMINING STAKEHOLDER PERSPECTIVES WITHIN A LOCAL MULTI-STAKEHOLDER COLLABORATIVE NETWORK

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University of Nebraska 2021

Advisor: Dr. Tamara Williams

The need for a STEM literate workforce has presented a complex issue on both the national and local level. The Omaha STEM Ecosystem was established in 2016 as a connecting agency to leverage the social capital of member stakeholders in addressing STEM workforce gaps by strengthening the availability of STEM pipeline learning opportunities in the Omaha Metro Area. This study presents a qualitative analysis of organizational documents and semi-structured interviews. Stakeholder groups were divided into Producer (Business, Government, and Non-Profit) and Consumer stakeholders (Education, Families, and Science Centers and Museums). Interviews for this publication present the Consumer stakeholder group, while the developed theory and implications are presented in a white paper combining the analysis of all six key stakeholders. The developed theory provides possible actions the Omaha STEM Ecosystem might take to bring, hold, and grow its stakeholder network in order to produce ongoing impacts on the local STEM ecosystem.

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To my Co-Researcher, Heather Daubert, thank you for walking a parallel path with me as we explored this process over the past nine months, through countless Zooms, amidst the disruption of a global pandemic. You spoke frankly when I needed to hear it, shared thoughts, questions, and ideas that refined my thinking, and held me able, knowing someone else was working just as hard to see this process through. Thank you for your trust, your humor, and your partnership.

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Chapter 1: Introduction

Multi-Stakeholder Collaborative Networks (MSCN) seek to solve complex problems through the sharing of resources toward a common goal (Traphagen & Saskia, 2014). MSCNs consist of many stakeholder groups and individual stakeholders. Although the collective focus of a common goal is shared by all, each stakeholder likely has their own subgoal particular to their context (Roloff, 2008, p. 235). It is important for all members of the MSCN to know and understand the shared common goal as well the unique and varied subgoals of different MSCN members.

The Omaha STEM Ecosystem seeks to bring diverse stakeholders from multiple sectors of the community together to promote high-quality STEM learning opportunities that will address the current and future workforce gap associated with STEM skill sets (Omaha STEM Ecosystem, n.d.). There are six key stakeholder groups in the Omaha STEM Ecosystem (OSE). Key stakeholders include government, science centers & museums, education, non-profits, business, and families. All OSE members share the common mission of building a stronger STEM community by connecting education and business development for tomorrow's workforce (Omaha STEM Ecosystem, n.d.). Additionally, stakeholders within the Omaha STEM Ecosystem hold individual subgoals specific to their particular role. Families seek engaging opportunities to develop future skills, businesses to provide for a workforce, nonprofits to assess participation count and growth, education to measure assessed skill development, science centers and museums to engage with visitors, and government institutions to promote economic growth. By focusing their resources and sharing their own expertise and experience, each stakeholder contributes an important part to the STEM Education pipeline.

Establishing a consensus of success criteria allows collaborative stakeholder groups to maintain the value of their individual role in the collaboration with other stakeholders while recognizing the relationship of the network's broader goal which their focus supports. Edward Freeman, in his work on stakeholder theory, referred to this as joint value creation (Freeman, 1994, p. 415). MSCNs functioning in this way are more equipped to bear the resources necessary by operating as a collaborative group rather than silos of isolated opportunity and outcome.

The Omaha STEM Ecosystem seeks to develop from its established foundation and accelerate its continued growth. Like other non-profit collaboratives, it benefits from an outside perspective of current impact and analysis of opportunities of growth.

Purpose Statement

Therefore, the purpose of this qualitative study has been to synthesize the shared and nuanced definition of success for all key stakeholder groups in OSE with the STEM lexicon.

Central Research Questions

1. How do the Omaha STEM Ecosystem's key stakeholder groups define success of the local STEM ecosystem?
2. What is the STEM lexicon within the Omaha STEM ecosystem?

Significance of the Study

This formal evaluation seeks to lay the foundation for a future impact assessment of the Omaha STEM Ecosystem. The subsequently presented framework establishes, firstly, a common STEM Lexicon and secondly, be used to articulate a shared vision for success. Both, in turn, provide the necessary elements for the organization to perform their collective impact assessment.

Operational Definitions

- **Omaha STEM Ecosystem - Multi-Stakeholder Collaborative Network** (MSCN) - A local extension of the National STEM ecosystem, comprised of multi-sector collaboratives with the shared mission of building a stronger STEM community by connecting education and business development for tomorrow's workforce (Omaha STEM Ecosystem, n.d.).
- **Key Stakeholder Groups** - As an organization, the Omaha STEM Ecosystem identifies the six key stakeholder groups as government, science centers & museums, education, non-profits, business, and families (defined through alignment with the Omaha STEM Ecosystem's interpretation of these sectors).
- **Local Lexicon of Omaha STEM Ecosystem** - The agreed meaning of terms held by individuals of a specific organization or group. Local Lexicon allows members to apply the same meaning to terms which may hold a broader meaning within general use, but has a specific understanding within the context of their collaboration.

- **Success** - Established criteria that aligns the values and actions of the organization across its stakeholder groups and is used to measure its fidelity in enacting those values.

Limitations

The scope of this study's findings are limited in application to the Omaha STEM Ecosystem. Participants in the research are members of the key stakeholder groups as defined by the Executive Committee. Stakeholders largely consist of committee members who share vested interest in the success of the Omaha STEM Ecosystem.

Initial document analysis occurred using artifacts supplied by the organization's leadership seeking evaluation. These may represent a limited perspective of the broader stakeholder experience within the Omaha STEM Ecosystem.

Interviews have been conducted via phone or video conference as a matter of convenience and public health due to current limitations of the COVID19 pandemic on meeting in-person. There is some consideration that in-person responses could differ from those received through this format.

Chapter 2: Perceptual Framework

Framework

The scope of this research has been to ensure a common STEM lexicon exists within the organization and to establish a shared definition of success for the stakeholders of the Omaha STEM Ecosystem.

In prior work with the Omaha STEM Ecosystem, Dr. Tracie Evans Reding established the complexities of resource awareness within this multi-stakeholder collaborative network. Through a perceptual framework, Dr. Reding showed that social network, common assets, innovation management, knowledge transfer, and social capital are critical cogs of the MSCN's functionality, and the shared norms and the roles of the innovators and bridgers within the organization are significant components (Reding, 2018, pp. 74-77).

This research is not intended to shape or form the Omaha STEM Ecosystem's values. Instead, the intent of this research is to build upon Dr. Reding's work and ensure all sectors of stakeholders are saying and valuing the same things.

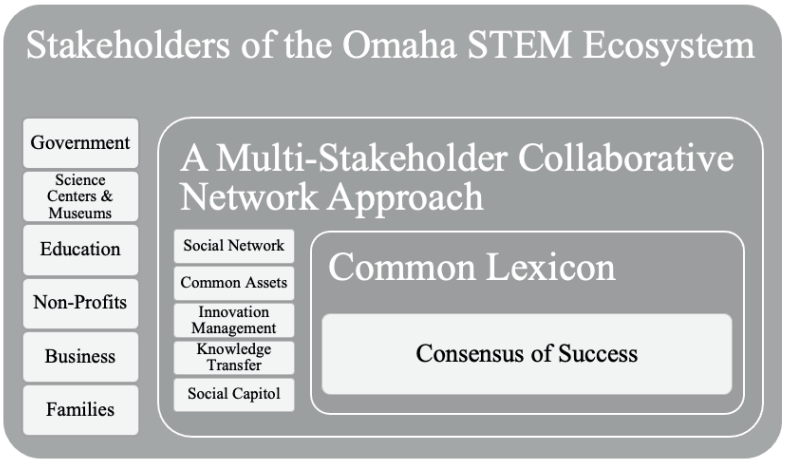

Figure 1

Perceptual Framework of the Study

The absence of an agreed-upon common lexicon makes it difficult to ensure each stakeholder has the same vision of success. In order for the group to truly define success, they must have a common understanding of the organization's goals to align their own efforts to those outcomes. The language needs to reflect the lexicon of the organization and not of its individual members.

Consensus building serves as the underlying foundation of establishing common success criteria in an MSCN. All stakeholders need to be committed to their role in the broader goal to maintain the collaborative unsilo-ed approach to accomplishing the group's goal. Within an MSCN "accomplishing anything significant or innovative requires creating flexible linkages among many players" (Innes & Booher, 1999, p. 412).

Chapter 3: Methodology

Central Research Questions

1. How do the Omaha STEM Ecosystem's key stakeholders define success within the local STEM ecosystem?
2. What is the STEM lexicon within the Omaha STEM ecosystem?

The results of the research reveal two key organizational tools: a shared vocabulary (STEM lexicon) across the stakeholders and a mapping of interconnected coding themes that both suggest opportunities for shared success and stakeholder pairings that are ready to pursue those efforts. This offers the organization a concrete path to pursue their strategic goals.

Design of the Study

The design of the research is similar in approach to grounded theory, but the result will be that the Omaha STEM Ecosystem will have a common STEM lexicon and a shared definition of success.

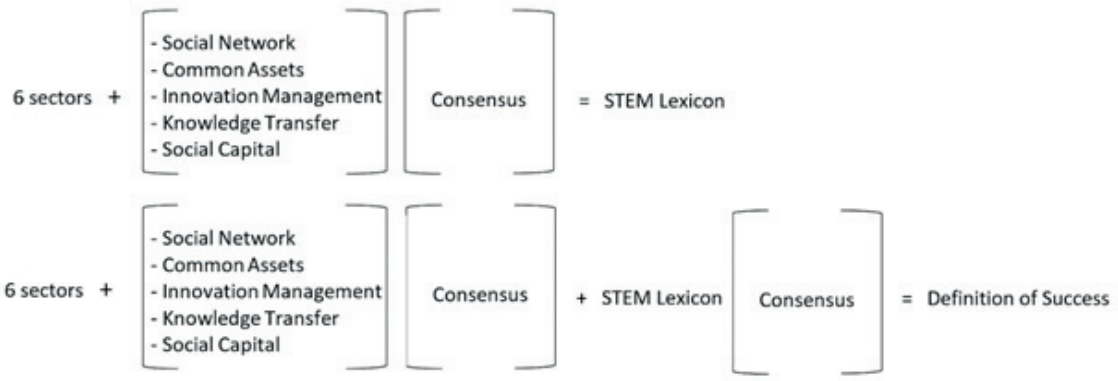

Figure 2

Design of Study Elements

As represented in Figure 2, when a multi-stakeholder collaborative network (MSCN) comes together and leverages their common assets and relationships for a common goal, they should filter that through an established lexicon. When the stakeholders operate without an agreed-upon common vocabulary, by default, each member will apply definitions from their own experiences and biases. This makes it difficult to ensure each group's actions align with the overarching goal of the MSCN. Establishing an agreed-upon STEM lexicon to be used within the MSCN is essential if the group is to achieve its mission.

When a common lexicon is in-place and widely used throughout the organization's subgroups and sectors, the MSCN is able to meet its mission and goals. Consensus allows the Omaha STEM Ecosystem, to establish a universal definition of success for the local organization. With this definition in place, the Omaha STEM Ecosystem will be better positioned to measure its effectiveness.

Participants

Participants of this study consisted of individuals identified by OSE as key stakeholders within the OSE Ecosystem. These are representative interviews with individuals participating on a voluntary basis. Participants' identity was kept internal to the organization and findings have been reported at the stakeholder group level. Researchers aimed to make the number of participant interviews equitable across the stakeholder groups.

Participant Data

As data was provided by the organization and was treated as non-identifiable aggregate records, there is minimal risk to vulnerable individuals or populations. Results

used to develop semi-structured interviews added to the library of resources used for continuous comparison and allowed for ongoing revision of coding until further relationships do not emerge.

The first stage of data collection was the gathering of key stakeholder documents. Documents were analyzed for frequency of common words and phrases to establish an initial coding scheme. Codes were evaluated for a second patter coding step. Finally, codes were analyzed for relationships within the data in order to draw conclusions from the analysis.

Stage two of data gathering involved semi-structured interviews with members of the key stakeholder groups. Interview participants were recommended by the Executive Committee of the Omaha STEM Ecosystem and contacted by the researcher through a formal invitation sent by email. Interviews were administered through video conference, recorded, and transcribed through the use of video captioning software. Text transcripts were analyzed within a qualitative coding platform. Transcripts are only identifiable as participants representative of their key stakeholder group.

Equitable representation of stakeholder groups is an important factor to ensure that interview results are representative of the broader organization. The researcher included a minimum of four participant interviews within each stakeholder group. Interview participants were invited from a rolling list of possible interviewees. If a requested participant was unavailable to participate the next participant was invited. When more than four interviews of one stakeholder group occurred, the researcher reported findings as a percentage of that stakeholder group's responses.

Data Analysis

The data for this evaluation was collected in two stages. The first stage was a document review of public-facing and internal OSE documents including committee meeting notes, meeting transcripts, and meeting minutes. The second stage of data collection was conducted through semi-structured interviews with members of all key stakeholder groups.

Table 1

Document Analysis and Semi-Structured Interviews

Foci	Data Collection	Analysis Process	Final Result
STEM Lexicon	Document analysis of internal and public facing OSE documents and interviews	Coding documents for common themes	STEM Lexicon established
Definition of Success	Document analysis of internal and public facing OSE documents	Coding documents for common themes	Partial definition of success started
Definition of Success: Consensus Confirmation	Semi-structured interviews of members from key stakeholder groups	Compile responses from interviews Constant comparison method	Shared definition of success established

An initial frequency analysis across documents provides a starting point for the development of a constant comparison coding approach. Documents were read and excerpts identified that demonstrate these codes. During the pattern coding stage, codes were re-evaluated to determine if individual codes carry common meaning. Documents were re-read to verify that codes still matched with the excerpts identified. Finally, codes were analyzed for relationships within and across documents. Established linkages

across the sectors identified where consensus of goals and success criteria existed, as articulated formally and observed through their preponderance within the organization's documents.

The use of a constant comparative coding approach to analysis of the data provided a structured mechanism to recognize patterns as they emerged. Constant comparative coding is typically operationalized as open coding, axial coding, and summary coding, from which conclusions can be drawn with minimized bias (Corbin & Strauss, 2014). Later the substitution of pattern coding for axial coding was selected as a better fit during second stage coding (Saldana, 2021, p. 322). Initial quantitative analysis of key terms and phrases establishes a coding scheme not influenced by the researcher's individual perspective. Subsequent excerpting and memoing more broadly identified the deeper meaning of the common STEM lexicon being used by the ecosystem.

Documents analyzed were those obtained from Omaha STEM Ecosystem and semi-structured interviews adhere to a planned script of questions designed not to influence the response received. Analysis of interview transcripts occurred after the interview with the same coding scheme applied from the document analysis.

For this study, the researcher analyzed the shared definition of success and establishing a shared lexicon. By looking at the dialogue within the stakeholder groups and between the stakeholder groups, this researcher identified and validated a common lexicon within the organization. By establishing this shared vocabulary and a clear, common shared vision of success, the continued collective work of the Omaha STEM Ecosystem has the potential to be accelerated.

Measurement

"Theory, empirical research, and practice all reveal that because cross-sector collaborations are so complex and dynamic and operate in such diverse contexts, it is unlikely that research-based recipes can be produced" (Bryson et al., 2021, p. 658). Because of the diversity of its members and the varied involvement of each, when trying to measure the effectiveness of an ecosystem, simply tracking the individuals and activities, let alone the cumulative impacts from the variety of experiences and settings is difficult (Allen & Peterman 2019; Morrison and Fisher, 2018; van Tulder et al., 2016). Further, while anticipated success is often discussed in multi-sector collaborations, it is not often measured because it is so broad that no one method or process works. Part of this comes from the desire to "jump in and get involved" and not worry so much about measuring a person's actions (van Tulder et al., 2016, p. 4). The challenge, then, is to understand all of the details of the collaborative well enough to produce good results with limited failure (Bryson et al., 2021, p. 657).

Allen, Lewis-Warner, et al., (2020) suggest that when an ecosystem does collect data, it should be intentional, transparent, and evidence-based. It should also involve multiple sources and the results should be applied quickly and effectively (Allen, Lewis-Warner, et al., 2020 p. 39). When an ecosystem does collect data regarding the effectiveness of an activity or event (possibly a survey or feedback from a focus group), they may consider looking at the activities provided, the participants, the student outcomes, and program quality outcomes (Allen, Lewis-Warner, et al., 2020, p. 36). These results should be shared across the collaborative partnership. This includes not just sharing what is working, but also where challenges may exist so initiatives can be

adjusted as needed (Asera et al., 2017). However, Allen, Lewis-Warner, et al. (2020) suggests stakeholders look beyond the total number of people attending, and instead use the surveys to ask the participants about their interests and attitudes to help build better student-based opportunities.

While there is a desire among some members of STEM ecosystems in various states to have a common data warehouse and assessment protocols, such processes do not yet exist. In the absence of this, van Tulder et al. (2016) suggests that members ask "Does the partnership provide additional ways of achieving the societal ambitions that would not have otherwise been possible?" (p. 11).

Role of Researcher

The outsider context of a researcher presents both an objective view and an unfamiliarity with the history, process, and experiences of the stakeholders. Within qualitative research, the bias of the researcher's interpretation is one consideration when interpreting the findings. In this study, the role of the researcher will be to gain familiarity with the work of the Omaha STEM Ecosystem while maintaining an external lens to the analysis of documents and semi-structured interviews.

Researcher Daubert:

As a researcher, I am a 49-year-old female doctoral scholar at the University of Nebraska in Omaha. For twenty-seven years, I have been an educator in one large, Omaha-area suburban school district. During my career I have spent twelve years as a middle school English teacher, four years as a district curriculum and instruction facilitator for math, industrial technology, and computer science, and eleven years as a middle school assistant principal.

I have no personal experience with the Omaha STEM Ecosystem or the key stakeholders, although my sister is the renewable energy practice lead for an engineering firm headquartered in Omaha. In addition, my current middle school does have science classrooms which have benefitted from grants offered by OSE's founders. My personal knowledge of STEM-related activities in the Omaha community is limited to what is promoted through advertisement.

Professionally, when I was a district curriculum facilitator in my school district, I worked directly with math, computer science, and industrial technology (now known as Skilled and Technical Sciences) teachers and departments. During that time, I also consulted with local businesses, Metropolitan Community College, the University of Nebraska's Charles W. Durham School of Architectural Engineering and Construction, and the Nebraska Department of Education Skilled and Technical Sciences (STS) division to ensure the district's STS curriculum prepared our high school graduates for post-high school level opportunities in the STS career field. I worked similarly with the district computer science department, although those consultations were narrowed to professors from Creighton University and the University of Nebraska at Omaha's Peter Kiewit Institute. Currently, as a middle level administrator, my involvement with STEM education is limited to supporting educators and district initiatives.

In preparation for completing this research I have joined the Omaha STEM Ecosystems contact list in order to receive communication and advertising on current practices within the organization.

Researcher Higginbotham:

As a researcher my individual background is as a 38-year-old male doctoral scholar at the University of Nebraska at Omaha. My professional career as an educator has spanned seventeen years within the elementary (kindergarten through sixth grade) level of education. Primary roles have included serving as a 4th grade, 5th grade, and 2nd grade general education teacher for the first eight years and as a building administrator and principal for the past eight years.

In both my personal and professional capacity, I have no direct prior relationship with the Omaha STEM Ecosystem. My prior connection to STEM related educational opportunities has primarily been through supporting extra-curricular events integrating STEM skills. While some non-profit groups I have interacted with are members of the Omaha STEM Ecosystem, my administrative role has been in supporting, but not directly planning, these educational activities. In preparation for completing this research I have joined the Omaha STEM Ecosystems contact list in order to receive communication and advertising on current practices within the organization.

Some additional familiarity with STEM Education was also present during my time of professional work as a 5th grade teacher at the Underwood Hills Focus School. This institution provided 3rd through 6th grade students a public education with a focus on leadership through technology and communication. In addition to integrating these themes into core content, the program provided daily after school enrichment opportunities also tied to the school's focus themes. As part of that program, I provided education experiences related to technology use including video production, block-based

programming, and basic skills in building and construction that might each be associated with typical STEM education activities.

Lastly, as a building administrator my role does regularly interact with external stakeholders that may be similar to the key stakeholders identified by the Omaha STEM Ecosystem. My role, in doing so, is typically to evaluate the alignment of offerings to the educational learning outcomes of elementary age students. Access to the programs and services of key stakeholder groups is limited to the consumer perspective, with primary interaction occurring at the student level. The exception could be considered in the Students and Families stakeholder group which is also a primary stakeholder within the educational community.

Chapter 4: Findings of Lexicon Analysis

Document Analysis

Introduction

This chapter shares the process and findings of document analysis performed to answer the second research question, what is the STEM lexicon within the Omaha STEM Ecosystem? Establishing this local lexicon was an important pre-requisite for developing a theory of success as well as a means for the organization to align stakeholder communication and collaborative efforts in meeting their shared vision.

Document analysis was selected for this purpose for several reasons. Documents are "constructed in particular contexts, by particular people, with particular purposes" (Mason, 2002, p. 110). A local lexicon, by its nature, carries specific meaning to the group that uses it. While the researcher's profession as an educator provides linkages to the stakeholder groups, documents provided a means to better understand the organizations use of terms with a discernable context, audience, and purpose to frame how words and phrases were used.

Description of the Sample

Documents used for this analysis came from three source categories. Public facing annual reports from the OSE website provided the organization's external manifestation of the STEM lexicon. Internal agendas and minutes of meeting were provided by the OSE Research and Advocacy Committee. These provided the internal use of the lexicon by an operating committee. Finally, the Omaha STEM Ecosystem had recently completed three roundtable discussions that included participation from across its six key stakeholders. Transcripts created from these videos provided representation of

how the lexicon was used by a broad representation of the OSE stakeholders. Including all three provided a diverse lens from which to establish how the organization functionally communicated about STEM.

Methodology of Analysis

To determine the most relevant terms to include in the lexicon, the qualitative research software MAXQDA was used with the Dictio plugin to run word and phrase frequency analysis (VERBI Software, 2019). Lemmatization was applied so that word variation by tense, form, or case were counted in their base form. From this list common words and phrases unrelated to STEM and the organization were removed. The phrase analysis also produced duplication of phrases and phrase parts. For instance, "The Omaha STEM" and "The Omaha STEM Ecosystem" represented the same phrase, identified at different phrase lengths and were merged. The selected word and phrase list consisted of 164 distinct words and phrases that occurred frequently across documents.

In a second phase of analysis the list was reviewed for words and phrases with similar functional meaning. These words and phrases were grouped together and the original documents reviewed to select which term would be used to represent this meaning. Both the frequency of the word or phrase and the number of documents it occurred in were considered in selecting the representative term. Finally, the documents were reviewed and a definition of the words and phrases composed to attempt to capture how the organization was actively using them.

The resulting list of 22 words and phrases was shared with the Research and Advocacy Committee to receive feedback. Discussion with the committee identified that

the list represented a starting point the organization could build on as both the stakeholder membership and nature of STEM learning progressed.

Results of the Analysis

Upon interpreting the results of the frequency analysis, the researcher observed the presence of categories of vocabulary that emerged. The researcher hypothesizes that these categories likely have some alignment with the context of their document origin. Terms such as *workforce*, *stakeholder*, and *goal* were representative of the public facing reports. The definitions composed for these were built on the ecosystem's expressed values and vision. Terms like *communication*, *skill*, and *collaboration* gave voice to the context of the six key stakeholders that OSE has identified. They demonstrate the value stakeholders within the organization put on these elements to meet their own needs as well as the goals of the broader ecosystem. Terms such as *evaluation*, *high-quality*, and phrases like *shared framework that evaluates the measurable effects of high-quality STEM programs* were suggestive of the internal dialogue of active committee work.

Understanding these three distinct lenses provided both an initial lexicon and a starting point for the research to frame coding of the semi structured interviews that are discussed in chapter 5. As seen in Appendix A, Table 5, words, and phrases were noted with *n* representing the count of unique uses across documents. The researcher also considered the number of documents a word or phrase was found in. When a term was used frequently, but in few documents, this suggested it was a topic of focus, but not broadly used. High count of use across documents and a high number of documents it was used in would suggest the word or phrase had continued to be discussed over time within the organization.

Interview Vocabulary Analysis

Introduction

In order to expand the reach of the vocabulary reviewed, interview transcripts were used as a further source to analyze vocabulary used by the organization. Interview transcripts added to the scope of terms included with the roundtable discussions and included some members of the STEM Ecosystem that were not active members of the operating committees.

Description of the Sample

As part of the broader review of the Omaha STEM Ecosystem's factors for success, researchers divided the stakeholder groups into two primary categories. For the sake of analyzing the interviews, all six stakeholder groups were included in the analysis to ensure that a comprehensive understanding of the organizations members was represented. Twenty-six interview transcripts were included in the sample.

Methodology of Analysis

As was used for the document analysis, the researcher used the MAXQDA Dictio plugin to run a word and phrase frequency analysis (VERBI Software, 2019). Records were lemmatized so that all forms of words were condensed to their base form. Common words, phrases and duplications based on partial and complete phrase lengths were combined. Finally, associated terms were identified based on the researcher's analysis of the interviews.

Results of the Analysis

To determine the most significant terms, vocabulary was analyzed for frequency across documents and count of documents that included the term (see Appendix A, Table 6).

Three terms were noted in every interview, *inform, Omaha STEM Ecosystem,* and *involve.* Each of these terms were associated with synonyms assigned based on the researchers' interpretation of the context. A second round of terms was found in greater than 75% of documents, including *community*, *Julie*, *email*, *opportunity*, and *school*. Lastly, an additional eight terms were identified that occurred frequently, and in more than 50% of interviews (see Table 7).

Cross-population of terms

The researcher observed that certain terms found frequently within the interviews matched terms found frequently in the document analysis. Matching terms from the two analyses may suggest lexicon that represents the broadest priorities of the organization and can be understood in the interpretation of results (see Appendix A, Table 7).

Chapter 5: Results of Stakeholder Interviews

Introduction

Following the analysis of documents, the researcher proceeded with a multi-phase coding process. Semi-structured interviews were performed based on the recommendations of the research and advocacy committee. These interviews sought to identify a response to the first research question, how do the Omaha STEM Ecosystem's key stakeholder groups define success of the local STEM ecosystem. In part, this also sought to identify if the articulated goals identified in the organization's public facing reports and internal communication, matched with the characteristics and actions that key stakeholders identified as indicators of successful implementation.

Coding Methodology

Following a grounded theory-like approach, coding was multi-phased and occurred simultaneously with gathering of interviews. Initial design of the coding process followed a constant comparison methodology as designed by Strauss and Corbin (Corbin & Strauss, 2014). In a constant comparison process "data are broken down into manageable pieces with each piece compared for similarities and differences" (Corbin & Strauss, 2014, p. 7). Initially this design was thought it would follow a classic open coding, axial coding, and summary coding process with a theory developed and supported at the summary level. However, the nature of the semi-structured interview responses and the researchers' observations did not fully align with this process, finding response to be related but not necessarily gradient upon an identified axis. Instead, the decision was made to implement pattern coding as a second stage process. Pattern

coding was selected for its alignment with "examining social networks and patterns of human relationships" (Saldana, 2021, p. 322).

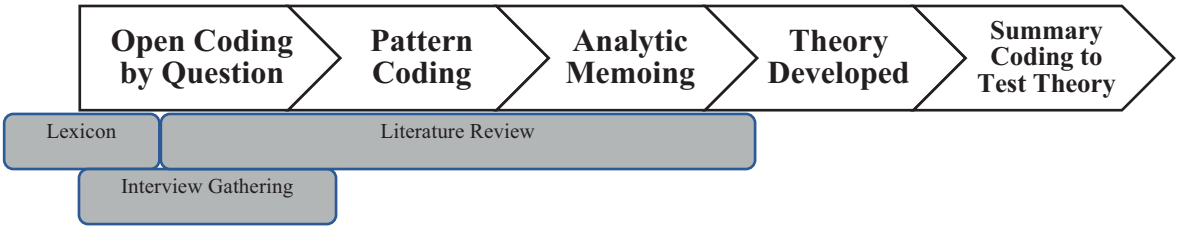

Figure 3

Interview Coding Process

During the pattern coding, initial open codes were grouped into categories or merged when initially applied open codes held the same meaning. Both open and pattern coding processes were completed using the Dedoose (2018) computer assisted qualitative data analysis software. Codes and categories are shown in the tables of Appendix B. Of importance to note at this time, is the influence of the initial document analysis in developing the initial open codes. The articulation of the common lexicon gave the researcher a context of terms to look for when open coding the interview transcripts.

Following the pattern coding the researcher took time to extensively apply memos to each pattern coded excerpt. Doing so allowed the researcher to clearly articulate how the excerpt applied to the that particular pattern code. The Dedoose (2018) platform allowed the researcher to further group these memos into patterns of their own, known as memo groups. As common meanings were identified within the patterns these groups were also able to be merged. The software allowed the researcher to determine the strength of these interpretations of patterns and develop a set of four summary codes that most strongly represented the researcher's observations of the stakeholders' success values.

Summary coding was completed on all documents allowing for analysis of strength of success factor within each stakeholder group and across stakeholder groups. These strengths of factor offer opportunity for future action in connecting stakeholders with similar articulated values of the Omaha STEM Ecosystem's success.

Open Coding

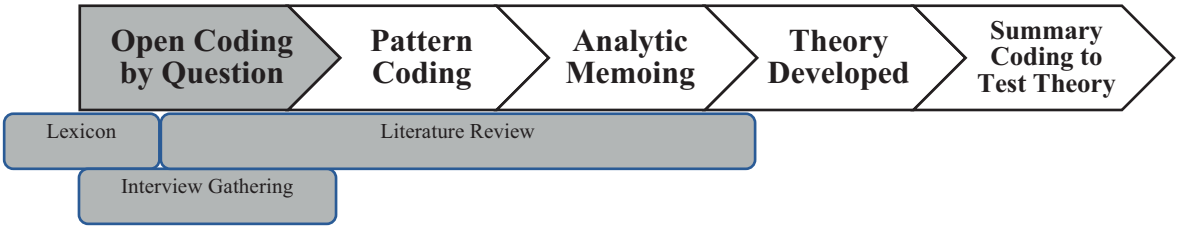

Figure 4

Interview Coding Process, Open Coding Phase

The table of open codes found in Appendix B, Table 8 shows two kinds of categories that emerged as a result of the constant comparison process. An initial functional category based on the question the interviewee was responding to grouped concrete responses indicating values of the various stakeholder groups. Categories outside of the specific questions also emerged as the researcher applied the lens of the document analysis.

Using the Code Application report in Dedoose (2018) allowed the researcher to visualize both the frequency with which codes had been applied to excerpts and the density within a given stakeholder group. Education Stakeholder responses focused on themes of networking for the sake of collaboration and connections, having personal contacts as a means to stay informed, seeking ways to engage the community, being involved as an extension of their job responsibilities, and frequently mentioned the elimination of silos from current STEM learning opportunities. Family Stakeholder

responses had the strongest focus on workforce development. They had an equally strong focus on community engagement to the education stakeholders, and they also indicated their involvement was based on duties from their employment. Science Centers and Museum Stakeholders excerpts noted a focus on networking with an emphasis on collaboration. They stayed informed through personal contacts within STEM organizations, and they mentioned as frequently as the education stakeholders a desire to break down silos of STEM learning opportunity.

Common stakeholder value emphasized an interest in supporting the STEM Workforce pipeline. Also, while individual stakeholder groups emphasized personal contacts as a means for staying informed, all noted the value of direct email contact as a way they received information regarding STEM opportunities.

These observations provided the researcher initial categories from which to re-assign the open codes. Broadly it was noticed that open codes could be consolidated and re-organized into four primary categories:

1. Communication
2. Community Awareness
3. Mission, Vision, and Values
4. Networking

A fifth category emerged that held codes that described the stakeholder and gave context to their response, labeled *Stakeholder Characteristics*.

Pattern Coding

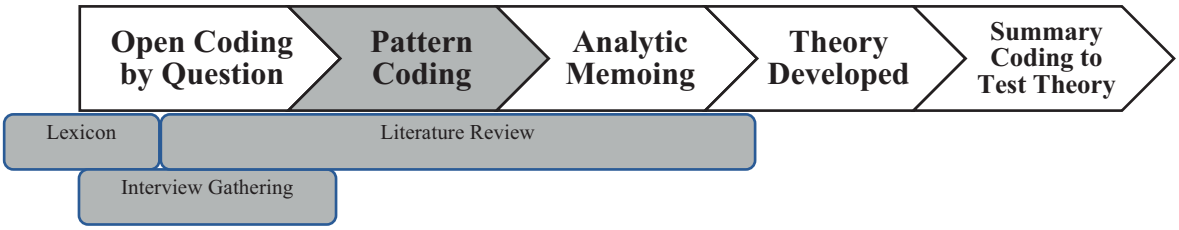

Figure 5

Interview Coding Process, Pattern Coding Phase

In moving from open coding to pattern coding several significant adjustments were made. As the researcher became more familiar with the kinds of values the interview participants were articulating, the four initial questions were removed and the response re-organized based on the categories that had been developed. Within the categories, patterns codes and subcodes were identified. The table of pattern codes shows how open codes were re-distributed, in some cases breaking down elements of the pattern to greater detail (see Appendix B, Table 9).

Whereas open codes were largely descriptive of what the interviewee had said, pattern codes began to show meaning and to create connections between the responses. While many of the excerpts coded as part of formal and informal communication related to how interviewees stayed informed, they also started to integrate stakeholders' perceptions of success for the organization.

Formal communication from the organization to its stakeholders of STEM opportunities as a clearinghouse emerged from the family stakeholder group. There was an articulated desire to see OSE's communication to represent a trusted resource.

> To me, it would be a success when, for families, there is a place to go to find out more about STEM events in the Omaha area. Right now, you sort of have to be a

> consumer of many different media platforms to figure out who is doing what. And so, I think an indicator of success would be when local businesses or local groups, community groups who are putting on STEM type events, when they start coming to Omaha STEM Ecosystem as a, I don't want to say catch all, but a clearinghouse maybe. Clearinghouse is a better way to say it, of local events that we can engage in as a family so that I can go to one place and have some confidence about that I'm not missing out on something (F3R2).

The act of communicating as a trustworthy source of information was also seen as part of community awareness. Research in the literature suggests that within STEM Ecosystems there is a need for agencies to serve as active brokers to meet the array of stakeholder needs. By the term *Active Brokers* this is suggestive of actively connecting key stakeholders with common needs and interests (Asera et al., 2017).

The Mission, Vision, and Values Pattern Category began to aggregate several kinds of responses. Success factors included financial support and sustainability and the ability to diversify both opportunities and access to STEM learning opportunities.

> One thing I didn't say, but I wanted to mention is, being involved in these things has really helped me to branch out and meet other people, other like STEM professionals. And so that has really helped me in the classroom, because then I can call on those people, I mean, not necessarily this year, but I could have those people come into my classroom. I've actually done a couple of WebEx's with my Girls who Code group, where people that I've met outside of education have asked, can I talk to the girls? So that's been a major benefit. I wish that more teachers had that because I don't think... I think there's kind of that line where

> people in other industries, they want to get in but they don't know how to get in (E2R2).

This led to how such opportunities would address the workforce gap identified as a key mission of the Omaha STEM Ecosystem.

> …our K through 12 education system, and even colleges, aren't completely aligned with what jobs there are today, and the good jobs there are today, and the jobs that sit empty, and breaking down barriers of parents having certain expectations for what their student is going to do or their child is gonna do post-high school (F2R2).

The fourth pattern category that emerged in this phase focused on networking, and in large part, how stakeholders stayed aware of STEM Resources. Dr. Reding's dissertation previously sought to analyze the resource awareness of stakeholders within the organization (Reding, 2018), and the Omaha STEM Ecosystem still largely serves to facilitate this. Responses also indicated that such resource awareness was a part of their stakeholder role and for families that resource awareness was a key area they were seeking to increase their knowledge in providing opportunities for their family.

> I know from my early days of studying to become a teacher there was always a lack of, especially in elementary education, a lack of people who truly were interested in teaching the sciences. Not always the math but... And back when I was in school technology wasn't as big of a focal point as it is and it needs to be today. So, I think getting to a point where our educators are more confident in touching upon this and less likely to avoid the topics because of what they don't know. Science is ever evolving, technology is a staple in our world, engineering

helps us become better problem solvers and math is essential to so many tasks, even in areas outside of STEM (S1R2).

The final pattern category captured excepts coded with elements of stakeholder characteristics, such as awareness of their stakeholder group and excerpts that identified the length of their relationship with the Omaha STEM Ecosystem. While these did not independently provide further information toward the research question, they may offer future insights through code-by-code analysis, looking to see if stakeholder characteristic, independent of identified stakeholder membership had a greater likelihood of responding with other coded factors.

Memoing for Interpretation

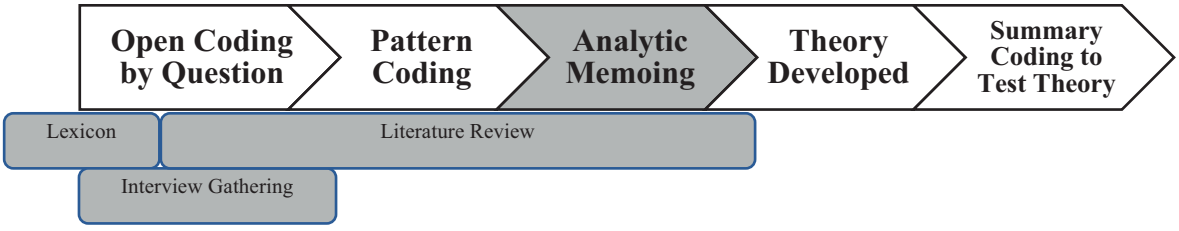

Figure 6

Interview Coding Process, Analytic Memoing Phase

In identifying the theory for the stakeholder's perceptions of OSE's success, the group, and reorganizing of codes only offered so much in interpreting the meaning and themes that began to emerge. Saldana notes that "Codes and coding are ways to progress toward a theory because they develop categories. And in your analytic memo writing of how these categories interrelate and transcend to themes or concepts, you build a foundation for theory development" (Saldana, 2021, p. 351). To that end the researcher next embarked by memoing each coded excerpt to reflect upon the researchers

interpretation of how that except represented the applied code. In seeking to answer the research question of how stakeholders define success, the researcher also created memo-groups within the Dedoose (2018) system noting "success = ___." These groups were often related to the category or subcategory of the pattern codes but also allowed for the researcher to include multiply coded excerpts with shared meaning (see Appendix B, Table 10).

As with code application, the frequency with which a memo was assigned as well as the scope of codes that a memo might be aligned to provide the researcher a lens from which to move toward summary coding and theory development. Frequency of memo application indicated that *community awareness*, *collaboration*, and *resource connection* were amongst the most frequently observed success factors interpreted from pattern codes. In addition, because multiple codes might exist with a single memoed excerpt, the frequency with which codes connected to memos indicated that *community engagement*, *equity of access* (to opportunities), *broad* (diverse) *opportunities*, and *confidence* in the organization as a *clearinghouse* (quality control), and means of *formal communication* to connect stakeholder groups were also shared values of success.

The use of Code Groups within Dedoose (2018) allowed the researcher to also analyze the strength of a particular assumption on organizational success by stakeholder group. These could be represented by the previously noted frequency across groups as well as by considering what factors were present across the stakeholder groups (see Appendix B, Table 10).

As the table demonstrates, frequently applied memo groups were aligned with the factors identified in pattern coding. In addition, *workforce opportunity*, *diverse (STEM)*

opportunities, *networking* (cross stakeholder promoting), and the organization's *impact* (support in connecting STEM providers and participants) *on STEM opportunities* were themes that emerged.

From Memos to Summary Coding

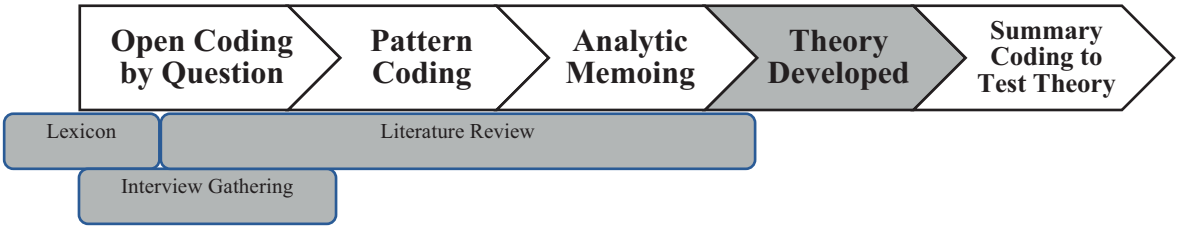

Figure 7

Interview Coding Process, Theory Development

Having both establish patterns within the codes and interpreted the application of those codes to excerpts through memos, the next step in the researcher's process was to develop an initial theory of success, the fundamental answer to the research question, and to then establish how that theory lived within the voice of the interviews.

> Memos also guide the next steps in further data collection, coding, and analysis. They present hypotheses about connections between categories and their properties and begin the integration of these connections with clusters of other categories to generate a theory. The basic goal of memoing is to develop ideas with complete conceptual freedom. Memos are 'banked' and later sorted to facilitate the integration of the overall theory (Holton, 2010, p. 9).

Table 2

Analytical Memo Application by Stakeholder Group

Memo Success =	Count of Times the Memo Was Applied by Stakeholder Group		
	Education	Families	Science Centers and Museums
Community Awareness	4	12	5
Collaboration	4	2	9
Resource Connections	3	1	7
Workforce Opportunity	2	4	1
Platform Usage	1	5	0
Networking/Promoting	3	1	1
Impact on STEM Opportunities	2	1	2
Engaging K-12	2	0	3
Financial Support	2	0	1
Individuals Served (count)	0	1	2
Diverse Opportunities	1	1	1
Members Involved	0	2	1
Keeping Current	2	0	1
Supports Whole Child	0	3	0
Excitement	0	0	3
Diverse Participants	0	1	1
Social Media Communication	0	2	0
Business Interest	0	1	1
Benefits to Stakeholder	1	0	0
The Community Values STEM	0	0	1
Beyond the Omaha Metro	0	1	0
A Coordinated System	1	0	0
Strong Leadership	0	0	1
Varied Membership	0	1	5

Sorting these memos had produced common threads by which the three interviewed stakeholder groups (Families, Education, and Science Centers and Museums) had articulated their commonly held values of success.

- Bringing together organizations to produce diverse STEM opportunities.
- Raising Awareness of opportunities and increasing equitable access for participants.

- Sustaining organizational relationships through collaboration and networking to promote STEM learning opportunities and share resources.
- Producing opportunities that engage STEM organizations and community participants in seeing themselves within the development of the STEM workforce pipeline.

These articulated factors draw the researcher to theorize:

> *The collective voice of all stakeholder groups concludes that through Networking, Collaboration, Diverse Opportunities, and Community Awareness, OSE will foster success by bringing people to the organization, holding them active, growing the participation, and producing varied opportunities which support the STEM pipeline.*

Figure 8

Theoretical Design of Organizational Success Factors

Summary Coding

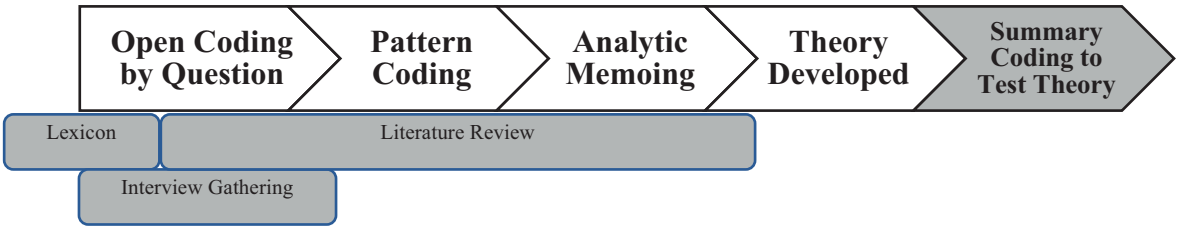

Figure 9

Interview Coding Process, Summary Coding to Test Theory

Having developed a theory, it was now necessary to ensure that theory lived within the words of the Omaha STEM Ecosystems stakeholders. Four summary codes were developed to use in a final round of coding: *collaboration*, *community awareness*, *diverse opportunities*, and *networking-promotion*.

Table 3

Percentage of Interviews with Responses Coded to Success Factors

Stakeholder	Collaboration	Community Awareness	Diverse Opportunities	Networking
Education (4 Interviews)	75%	100%	100%	75%
Families (5 interviews)	40%	100%	60%	0%
Science Centers and Museums (5 interviews)	40%	80%	80%	100%

Diverse Opportunities

The stakeholder view on providing diverse opportunities followed two distinct lines of understanding. On the family side, greater diversity of opportunities was seen as a means to address equity of access to STEM opportunities.

> Really, I think there's so much discussion now on equity and like, how do you, when we look at STEM careers, there are definitely gaps in diversity and how do you start to plant those seeds? How do you help people understand this is a career option? (F1R2).

Families sought ways that these opportunities might allow a diverse potential workforce to see a future STEM career path.

> I think a lot about kids that are children of color who maybe have it's even less accessible in some of these careers, or there need to be people that look like them to be the spokespeople, for those careers. And just making sure that all youth are being exposed to these opportunities and have mentors and people to look to (F2R2).

By comparison, the Education and Science Center and Museum stakeholders are seeking to expand their resources and reach.

> Well, what we would like to do is be a strong partner throughout the Greater Omaha Community and going further, besides the traditional urban underserved communities where we have a variety of activities, we want to reach the rural underserved communities, the more isolated communities that can't get to us, and we believe that as a participating member with the Omaha STEM Ecosystem, not only will we be able to take our already excellent capabilities, we'll be able to lend some credibility and some teaming to our organization, so that as a group, we're all together are taking care of the widest majority of kids, of students approaching those STEM careers (S4R2).

> Building pathways is just becoming huge, which is what really OSE is all about, right? Exposing students to STEM, building pathways for students, and helping them to not only go through K-12, to higher ED, to a job (E3R2).

"one of their (OSE's) main goals is to be able to partner with educators and to like offer opportunities for students to experience STEM activities" (E2R2).

Community Awareness and Engagement

Next the researcher looked for evidence of the Omaha STEM Ecosystem's role in raising awareness. The theory also proposed this in two ways, awareness and engagement of individuals and organizations in STEM opportunities, and awareness of the Omaha STEM Ecosystem by the community as a *go to* for STEM resources.

> To me, it would be a success when, for families, there is a place to go to find out more about STEM events in the Omaha area. Right now, you sort of have to be a consumer of many different media platforms to figure out who is doing what (F3R2).

> As a parent, my hope is that it'll make it easier for me to find and sort through opportunities that my kids are interested in, that they'll benefit from and give me some clarity of what's on the horizon so that when they get to that grade or the next grade or when they get to high school and all these different kind of milestones, I can go, "Hey, now you can go check out this activity or now you could go do this thing or be part of this organization" or whatever the case is and right now it's very much limited to what I get through the grapevine and other parents that I might see at activity (F4R2).

Comparatively, a member of the education stakeholder group emphasized the role OSE might serve in raising awareness amongst participating organizations.

> Collaborating, connecting, communicating really becomes the focus of the organization. So, we don't do it, but we put in place a network that allows this to take place, whether it's for the stakeholders being the community members, the parents, the kids, the students, the schools, the industry, basically the entire community. So, when we are able to tie that together and they are better able to help students learn, know, and experience STEM careers, we can get them on the path to become working professionals. That's our job. And so, the OSE can be instrumental in doing that in the collaboration, the communication, the information (E3R2).

Collaboration

The role of collaboration was largely represented by the voice of participating organization or by family stakeholder's whose professional capacity raised their awareness to how collaboration might sustain individual organizations in meeting their shared vision.

> One thing I didn't say, but I wanted to mention is, being involved in these things has really helped me to branch out and meet other people, other like STEM professionals. And so that has really helped me in the classroom, because then I can call on those people, I mean, not necessarily this year, but I could have those people come into my classroom. I've actually done a couple of WebEx's with my Girls who Code group, where people that I've met outside of education have asked, can I talk to the girls? So that's been a major benefit. I wish that more

> teachers had that because I don't think... I think there's kind of that line where people in other industries, they want to get in but they don't know how to get in, or they don't know how to meet educators, but then you also have educators, "oh, I wish I knew people that worked in these fields so they could reinforce that career aspect." So, I just wish there was a way to bring those people together" (E2R2).

> And I think that's probably why the STEM Ecosystem came together, is that we knew so many different organizations were working on really similar things. So, I'd say that success for that organization, for the community, is that the collaborative aspect of it (S2R2).

Though the family stakeholder group may not be as present in the organizational collaboration upfront, stakeholders from this group did identify the value of organizational collaboration as well.

> That's one component of what I mean by trust. The other one would include that the local providers whoever they may be, whether it's a Union Pacific putting on a drone camp or even the local public schools running STEM Camps in the summer or things like that. Once they start trusting each other as well, I think there'll be more confidence on the family's part to go to what OSE has to offer (F3R2).

Networking

The final representation of success within the theory was limited to the organizational stakeholders (education and science centers and museums). The science center and museum interviews showed a particular focus on their value in OSE as a

channel of co-promotion. This factor of success reminds that each stakeholder, while valuing the goal of addressing the workforce gap, likely has its own focus and strength that is part of its day-to-day focus.

> So, over the years in my positions I've had to develop a variety of networking systems and being engaged and involved and aware of what's happening locally at the school district level, and then also at the university level to see what direction they're going in and see how we can partner or help at that local level (S3R2).

> I think it's important for us all to work as a community. I think we all can support each other. You know, when somebody comes to me at the (location) and asks us to do programming that I know another organization is more specialized in it, I send them off to the other organization (S3R2).

Chapter 6: Literature Review

Introduction

In this grounded theory study, the literature review has occurred simultaneous to interviews and analysis. This parallel review of literature within grounded theory allows the researcher to know what topics are relevant (Silverman, 2004). Specifically, the researcher's role as an educator and parent of a child interested in STEM, places him parallel to two of the Omaha STEM Ecosystems targeted stakeholder groups. Though not directly participating in the targeted agency's work, it was important for research to occur concurrent and following interviews so that studied elements reflected the values of active stakeholders rather than the researcher's personal perspective. As stakeholders shared their perceptions of success, paths for investigation emerged. This, in turn, helped the researcher to enhance sensitivity to the data. As the theory was developed the role of the literature transitioned to confirmation and deeper investigation of findings (Corbin & Strauss, 2014). This literature review, then, seeks to provide the researcher a base for processing and connecting the expressed values of the stakeholder subset in this study.

Why Multi-Stakeholder Networks Are Needed

The concept of a multi-stakeholder collaborative network (MSCN), while an increasingly popular approach to large scale social problems (Foundation for Development Cooperation, 2003), is not broadly evaluated in the literature (Reypens et al., 2016). A few key contexts explore the collaboration of varied stakeholders in the realms of diplomacy (Bäckstrand, 2006) and in community health (Hearld et al., 2019). Where established, "multi-stakeholder partnerships are typically formed when a social issue is considered too complex and multifaceted for a single organization or sector to

address alone" (MacDonald et al., 2019, p. 410; Selsky & Parker, 2005). As a result, diverse stakeholders undertake efforts to cross boundaries of individual organizations (Nissen et al., 2014; Reypens et al., 2016).

In conceptualizing how such networks function, Bäckstrand describes them as "voluntary cooperative arrangements between actors from the public, business, and civil society that display minimal degree of institutionalization, (and) have common non-hierarchical decision making structures" (Bäckstrand, 2006, p. 293). The collaboration of these stakeholders can promote collective understanding and problem solving with more innovative solutions and supporting the buy-in of stakeholders (MacDonald et al., 2019). The Foundation for Development Cooperation issue paper notes "they are about sharing not shifting risks; finding innovative ways to pool resources and talents based on each parties' core strengths; and designed and maintained over time in such a way as to deliver mutual benefits for all collaborating parties" (2003, p. 8).

However, Reypens, et al. (2016) notes that when such groups come together it can become difficult to gain consensus, compromise, or ensure all stakeholders are part of the conversation. Stakeholders bring with them independent organization mandates, interests, strengths, and weaknesses (Foundation for Development Cooperation, 2003). To that end, it is important to understand some of the many names and models sometimes identified as MSCNs and define what they are and are not.

Defining Multi-Stakeholder Collaborative Networks, Identifying their Forms

For the purposes of this study, an operational definition that a Multi-Stakeholder Collaborative Network (MSCN) is the collaboration of stakeholders from the six key stakeholder groups with the Omaha STEM Ecosystem's shared mission of building a stronger STEM community "by connecting education and business development for tomorrow's workforce" (Omaha STEM Ecosystem, n.d.).

In order to more broadly explore the ways in which MSCNs are represented in the research, an MSCN may be referenced under several common titles. Broadly, the Foundation for Development Cooperation (2003) offers one of the foundational terms of a Multi-stakeholder partnership (MSP). These partnerships are noted as "an alliance between parties drawn from government, business and civil society that strategically aggregate the resources and competencies of each to resolve…key challenges (Foundation for Development Cooperation, 2003, p. 3).

A second umbrella of such collaborative practices falls under the Public Private Partnership label (PPP). "From loosely coupled collaborations to strict contract-based partnerships, PPPs come in different shapes and sizes" (Warsen et al., 2018, p. 1166). Common, and more pointed to these, is the specific alignment of government and business. In this aspect the Foundation for Development Cooperation (2003), cautions that while PPPs may represent this kind of collaboration, for the purposes of viewing them as a collaborative network of stakeholders, this should not include those PPPs based on client-contractor relationships in which, often government, contracts with the private sector to address a problem with greater efficiency or innovation than a government entity is typically able to do (Foundation for Development Cooperation, 2003). Such

narrowed arrangements “often don’t engage the full set of stakeholders that affect the issue” (Kania & Kramer, 2011, p. 39).

Finally, one of the most frequently used representations of MSCNs is found in the terms Cross-Sector Partnerships and Cross-Sector Collaborations (Kolbe et al., 2015; Regional Educational Laboratory Program West, 2017). These sectors may align with the traditionally identified groups of government, business and civil society, and in so doing, would also encompass the six stakeholder groups referenced by the Omaha STEM Ecosystem (n.d.) Whereas collaborative partnerships are noted as independent individuals and organizations sharing “human and material resources so they can accomplish objectives” (Kolbe et al., 2015, p. 766), these two can represent contractual rather than collaborative relationships. The latter, in which cross-sector groups “collaborate more intimately in order to solve local issues, strengthen community relations, and ultimately fulfill their missions more effectively” (Ihm & Shumate, 2019, p. 475).

Challenges Facing Multi-Stakeholder Collaboration

Partnerships, Asera, et al. notes are often “complex and messy, and can lead to high levels of stress among the leadership (Asera et al., 2017, p. 34). “Collaborations are subject to both competitive and institutional pressures that significantly affect their formation as well as long-term sustainability” (Bryson et al., 2006, p. 45). Within the Omaha STEM Ecosystem context, they have identified a common lexicon as a necessary step to overcome communication challenges, a factor along with working style and individual priorities and processes noted in the work of Reypens, et al. (2016).

Where then, does the literature lead us to recognize the balancing point between contractual partnership and decentralized collaborative networks? "It is clear that large-scale impact does not occur by simply bringing various stakeholders together around a common agenda and then offering them funding for planning and implementation," (Easterling et al., 2013, p. 105). Easterling et al. further note the importance of a backbone organization in coordinating high leverage practices to support purposeful collaboration among groups of stakeholders (2013). These agencies, alternatively labeled as brokers in other research, help to manage the often intense and complex work of collaboration among actors with different opinions, personalities, organizational mandates, and turf to protect" (Easterling et al., 2013; Meehan et al., 2009; Silver & Weitzman, 2009).

Multi-Stakeholder Collaborative Life Cycles: A Means of Narrowing Focused Collaboration

> Cross-sector partnerships offer the potential to advance educational and economic outcomes. However, the development of such partnerships requires all stakeholders to cultivate a 'long view' a perspective that emphasizes a 'slow and steady' approach to building relationships, cultivating trust, and facilitating collaboration (Asera et al., 2017, p. 35).

These partnerships and collaborations present themselves in a variety of forms from parallel dyads (Davis, 2016), to participant governed networks (Provan & Kenis, 2007). Whereas dyadic partnerships develop strong relationships, they risk developing mistrust amongst network members outside the dyad and a lack of awareness of each dyads efforts (Davis, 2016). Participant or shared governance functions when there is a

high degree of commitment to network-level goals and a means of communicating progress frequently, but risks dissolution when individual network members interests are not as strongly tied to consensus of network goals and those partners may be seen as not equally contributing to the bigger goals (Provan & Kenis, 2007).

Roloff (2008), suggests that, in reality, multi-stakeholder networks and cross-sector collaborations typically exist along a continuum of how they collaborate and govern themselves. She refers to this as a *life cycle* consisting of seven phases, initiation, acquaintance, first agreement, second agreement, implementation, consolidation, and institutionalization or extinction (Roloff, 2008). The specifics of these stages and parallel representations from the research are shown below

Initiation Phase

Initiation is described by Roloff as the point in which the different sectors come together, typically in response to a problem. Often networks at this phase are initiated by a reputable person or organization who helps to select organizations to be invited to the network. Roloff notes that this membership is likely to change over time, often expanding as other organizations see similar stakeholders to themselves invited and seek to join the effort either because of a shared commitment to solving the problem or not wanting to be left out (Roloff, 2008).

Acquaintance Phase

As a core group of stakeholders begins to develop relationships they become familiar with each other's interests, approaches, and develop a common discourse language around the problem and process they intend to use to address it (Roloff, 2008). Roloff references Torgerson's work on network governance (2003) in this phase noting

that participants need both significant commonalities and disagreement, and must learn to not only recognize, but respect other stakeholder groups concerns and to accommodate those in future proposals. The acquaintance phase promotes trust building critical to taking shared action to resolve the problem (Reypens et al., 2021).

First Agreement

Next in the lifecycle model is the first agreement. While all stakeholders have agreed to a common problem that initiated the network, the complexity of stakeholder interaction and individual interests results in a consensus building process to articulate the common problem description. Unless networks fully define the problem they are likely "lead to an aimless discussion that does not result in any action" (Roloff, 2008, p. 318; Burchell & Cook, 2006). Roloff notes this phase may take longer than might be initially perceived. Joining the network was assumed to be a pre-existing agreement to the problem, however stakeholders may display strategic behavior in order to reduce the burden of their role in a future solution, an action that may negatively impact the network cohesion. Furthermore, as additional stakeholders join the network, they may initially question the agreed upon problem description (Roloff, 2008). Conflict management in the first agreement is an important consideration that will be approached in the section on the role of Backbone / Broker organizations.

Second Agreement

"The aim of the second agreement phase is to compare different solutions available and to select one or more for implementation" (Roloff, 2008, p. 319). During this phase stakeholders must come to agreement on both a solution they believe addresses the problem and that does not ask too much of particular stakeholders. Recalling

MacDonald et al.'s assessment that the network was formed because the problem was too complex for a single organization or sector to address (2019), yet it is likely that certain stakeholders have greater resources than others, and are turned to, as such, to provide the mechanism to implement a solution. Under such circumstances Roloff notes that the network should review its problem definition again to determine activities all stakeholders can commit to as a part of the second agreement (Roloff, 2008).

Implementation Phase

It is suggested that when the implementation phase occurs, "an exodus of disappointed and dissatisfied participants is not unusual" (Roloff, 2008). This is attributed to disagreements they may have conceded to in the second agreement, but which they are ultimately unwilling to invest in. Roloff identifies the implementation phase as the place where stakeholders shift from a focus on communication to cooperation and action. As actions are implemented organizations need to see incremental gains even if the larger problem is not immediately solved for the stakeholder network to hold together. In addition to any problem related outcome this success could be in the organizations cooperation in implementing and may result in further revision of the problem definition (1st agreement) and actions (2nd agreement) (Roloff, 2008).

Consolidation Phase

The change in problem definition and actions may, in turn, result in changes within the network membership. This may further impact the problem definition and actions. Remaining and any new stakeholders now enter what Roloff describes as consolidation. During this phase the network often formalizes procedural rules for

deliberation, division of work, and contributions between stakeholders. The network begins to take on a role as its own organization, with membership from the stakeholder groups. Provan and Kenis (2007), might position this the time when a Lead Organization might emerge in the governance of the network. If the network has shown success in their actions it may also attract further stakeholders, these newcomers having waited to "invest in a tested solution rather than conduct an extensive trial and error phase" (Roloff, 2008, p. 321).

Institutionalization or Extinction Phase

Roloff's lifecycle model suggests that multi-stakeholder networks often alternate between deliberation and action, a process that can become increasingly time consuming for the stakeholders which may have their own agenda of problems and actions as well. If, as they continue to iterate new problem definitions or new implementations, the network is unable to maintain an adequate level of investment from stakeholders, it may ultimately move to extinction. It may also be possible for the network to move to extinction if the problem is adequately addressed. Institutionalization may also appear as a dissolving of the network if corporations or government bodies take on the successful actions the network has established to meet the goal (Roloff, 2008).

Cross-Sector Collaboration Governance

Cross-Sector Collaboration, as mentioned previously, may represent a pairing or a multitude of stakeholders. Either as part of the deliberation and action cycle or as part of an institutionalized action plan, successful cross-sector collaborations are seen to have a need for some level of governance in order to resolve conflicts and continue efforts toward solving the problem (Provan & Kenis, 2007). Provan and Kenis present three

suggested formats of governance that may be implemented, Participant-Governed, Lead Organization, and Network Administrative Organization (Provan & Kenis, 2007). Each form is, in turn identified with participant traits that likely suit a collaboration to this particular form of governance.

Participant-Governed

Participant-Governance is suggested to be the most common form. Organizational representatives from the different sectors participate in collaborative processes. They "depend exclusively on the commitment of all, or a significant subset of the organizations that comprise the network" (Provan & Kenis, 2007, p. 234). It is suggested that participant-governance is most effective when there is a high level of trust among the collaborating participants, when problem definition and goal consensus is high, and when a need for coordinating the collaborators is low. This is often, though not exclusively so when there are a small number of stakeholders.

Lead Organization

With a moderate number of collaborators, it may be necessary for one of the participating organizations to take a lead role. Lead Organization governance places one organization as a broker to information and actions of the other participants. They may dictate goals and actions. So long as they are seen as an expert, and other sectors have trust in both the lead organization and the actions collaborators are expected to take, Lead Organization governance may be efficient and effective.

Network Administrative Organization

A third form of governance is that of a Network Administrative Organization. This format is suggested as necessary when the stakeholders represent a larger number of

organizations, such that they may not be fully aware of the other stakeholder's needs and resources. When such governance consists of only an individual they may be termed a "Broker," (Provan & Kenis, 2007) a concept that will be explored further. We will also explore when that administration takes the form of an organization, sometimes termed a "Backbone Organization" (Asera et al., 2017; Kania & Kramer, 2011). Such governance facilitates resource awareness across the network and helps maintain goal consensus.

Backbone Organizations

Throughout the key stakeholder interviews networking and collaboration were common themes that stakeholders felt would lead to success. Networking, as it was referenced in the interviews, largely represented the desire for partner organizations to promote other OSE stakeholders. Collaboration focused on stakeholders' desire to work together toward, or at least not in competition with each other, providing additional opportunities. Given OSE's large and growing number of members it fits with the Network Administrative Organization model presented by Provan and Kenis (2007). This role takes on at least three other common names in the literature, "Broker" (Stadtler & Probst, 2012; Winch & Courtney, 2007), "intermediaries" (Howells, 2006), and "backbone" (Asera et al., 2017).

In an analysis of how these individuals and organizations support the collaboration of stakeholders, Howells described this role as intermediaries for information (2006). He uses the term to describe individuals of firms that bridge, broker, or serve as a superstructure to organizations. They help to link and transform relations within a network or system (Howells, 2006).

Stadtler and Probst describe the broker role in three sub-roles throughout the life of the stakeholder collaboration. These consist of "convener," bringing together the stakeholders likely to be able to address the problem, "mediator" helping to navigate differences in how the stakeholders seek to approach the problem definition and solution, and "learning catalyst" recognizing areas where the collaborating stakeholders may need additional knowledge to fully address the identified problem (Stadtler & Probst, 2012).

The preferred term that was identified in the lexicon of the Omaha STEM Ecosystem is as a backbone organization. Backbone support is described as convening, facilitating and offering logistical assistance and connections to a set of collaborative groups (Asera et al., 2017). "Coordination takes time, and none of the participating organizations has any to spare. The expectation that collaboration can occur without a supporting infrastructure is one of the most frequent reasons why it fails" (Kania & Kramer, 2011, p. 40). Kania and Kramer's description fits closely with the Omaha STEM Ecosystem's strategic planning documents and with the values expressed by stakeholders in interviews. Backbone organizations, in the best of circumstances, are able to focus attention, create a sense of urgency, to apply pressure to stakeholders without overwhelming them, and when needed to mediate conflict among stakeholders (Kania & Kramer, 2011).

Stakeholder Theory

Through both their annual reports and strategic plan, the Omaha STEM Ecosystem identifies eliminating "silos" as an important action step toward addressing their mission. Document analysis and lexicon proposal suggest that this term is to indicate both a collaborative approach to providing STEM learning opportunities and to

prevent stakeholders from competing with each other in providing opportunities. Stakeholder interviews echoed this value by identifying success occurring through stakeholder networking and collaboration.

Stakeholder Theory emerged in the early 1980s as an extension on the term "shareholder," as a means to recognize that, for both ethical and operational reason's they needed an awareness beyond those that hold specific ownership. Edward Freeman receives much of the credit around Stakeholder Theories initial articulation and defined stakeholders as "any group or individual who is affected by or can affect the achievement of an organization's objectives" (Freeman, 2010, p. 5). Freeman and subsequent authors tended to frame the impact stakeholders have on an organization's achievement in the context of how their needs being met or not met might have the potential for damage (Garvare & Johansson, 2010).

Trust is articulated as a significant factor in managing stakeholders (Greenwood & Buren, 2010). Specifically, Greenwood and Buren note trust between the organization and the stakeholder in a transactional way. When the stakeholder invests resources in the organization, "the firm owes a duty to the stakeholder to maximize benefit" (2010). Because the Omaha STEM Ecosystem serves as a connection point for multiple stakeholder groups, stakeholder trust is present not only in the stakeholder's trust of OSE but in OSE's ability to moderate the development of trust amongst stakeholders.

Each stakeholder and each stakeholder group within the Omaha STEM Ecosystem essentially serve as independent organizations. Serving as a backbone the Omaha STEM Ecosystem owes, for example the educational stakeholder group as well as individual district's, schools, and educators returns commensurate with their investment

(Greenwood & Buren, 2010). That return, is represented in engagement through stakeholder dialogue that, in turn, directs the larger organization (Jonas et al., 2018). This inter-organizational view of engagement fits strongly with the notion of consensus, and specifically with an organizational view on consensus known as Strategic Consensus.

Strategic Consensus

Articulated in the lifecycle of multi-stakeholder collaborations (Roloff, 2008) and through stakeholder theory (Freeman, 2010), it is in a collaborative organizations best interest to seek consensus rather than majority rule in managing inter-organizational strategies. Though Roloff indicates that this still may lead to the exit of some stakeholders during the 2nd decision stage of the collaborative lifecycle, it is not a guarantee that all remaining stakeholders will independently work toward the best interests of the organization (Roloff, 2008).

Though individual teams within an organization have their own roles and responsibilities, the interdependent pursuit of the organization's goals means that the action of any team or stakeholder within the organization influences the others (Porck et al., 2020). Strategic Consensus Theory, described by Kellerman as the inter-team awareness of each other's work and common strategic effort toward shared outcome, has been positively associated with organizational performance (Kellermanns et al., 2011). Conversely, when stakeholders primarily identify with their individual group, they may see other teams as not adhering to their group's prototype. Strong group identification is achieved by comparing their group to others, possibly resulting in outgroup derogation and ingroup favoritism (Fiske et al., 2010). "Intergroup Collaboration, and hence intergroup leadership, is very much an issue of identity" (Hogg et al., 2012, p. 233).

That said, the literature is also clear that consensus building works, as might be expected, when each team believes they have reached the best possible decision (Dess & Origer, 1987; Wodak et al., 2011). High quality agreements achieved through consensus building are found to be more durable than decisions made by voting, litigation, or negotiation (Innes & Booher, 1999). Though each leader in such an organization brings their own strategies to bring such teams together, at least three findings are recommended from the research in promoting strategic organizational consensus, avoiding overzealous discourse by the leader toward a particular action (Dess & Priem, 1995; Wodak et al., 2011), ensuring all impacted stakeholders are included in discussion and consensus decisions (Balogun & Johnson, 2004; Wodak et al., 2011), and engaging the stakeholders as co-managers of the discussion, as the failure to do so can lead to individual team autonomy when the leader overly facilitates the discussion (Mantere & Vaara, 2008; Wodak et al., 2011).

Best Practices in Successful Cross-Sector STEM Collaborations

The Committee on STEM Education of the National Science & Technology Council produced a 2018 report *Charting A Course for Success: America's Strategy for STEM Education*. In this report they articulated a five-year strategic plan consisting of four key pathways that the US Federal government would support. These include to develop and enrich strategic partnerships, to engage students where disciplines converge, to build computational literacy, and to operate with transparency and accountability (Committee on STEM Education, 2018). The first of these aligns with the research previously presented in this literature review, and is supported through three discrete objectives: to "foster STEM Ecosystems that unite communities, increase work-based

learning and training through educator-employer partnerships, and blend successful practices from across the learning landscape (Committee on STEM Education, 2018, p. 9).

The STEM Learning Ecosystem's Communities of Practices (SLE CoP) represents a leading voice supporting the development of local STEM Ecosystems for implementation of these objectives. This network consists of 89 local ecosystems to date, who, while self-managed, emphasize "collective knowledge and action" ("FAQs," n.d.). A two-round survey of twenty-one of these participating ecosystems identified eight critical factors for ecosystem development and success. These factors included "partnerships, leadership, pathways, educator capacity, mission, community, STEM literacy, and interest" (Vance et al., 2016, p. 8).

Partnerships among the interviews largely focused on cross-sector collaboration between K-12, business, Out of School Time (OST) organizations, with growing awareness of partnership between OST and higher education. Business partnerships were aligned with the opportunity for STEM mentorship for both educators and students. OST partners dually identified as non-profit organizations, which are often embedded in the community and offer greater access to formal STEM learning environments such as museums. Finally a practice recognized as important for the partnership of OST/Non-profit organizations and in-school opportunities (K-12 and higher education) was the active alignment of curricula and activities (Vance et al., 2016). Similar partnership practices were identified in a 2017 case study of STEM CoP which found peer-to-peer relationships amongst the community of practice members and within the individual

ecosystems were an important part of sustaining successful implementation (Kezar et al., 2017).

Next in priority of ecosystem interview responses was with regard to the nature of ecosystem leadership. Ecosystems identified four critical leadership responsibilities, "connecting – convening partners and fostering relationships, managing – giving direction and employing strategies to attain goals and the larger vision, organizing – structuring meetings including setting agendas, and funding – obtaining fiscal resources" (Vance et al., 2016, p. 19). Ecosystems specifically identified the active nature in which leaders needed to move from the recruitment of ecosystem partners to the cultivation of specific cross-sector connections. Leaders were also tasked in seeking evidence of the ecosystem's effectiveness as an important role both for the organization's awareness and in keeping stakeholders partnered with the ecosystem through awareness of impact.

Pathways was the next factor, focusing on the STEM Workforce pipeline. Respondents focused on the strategic partnership of business, higher education, K-12, and OST. Mentorship was again identified as a key action that ecosystems found success in. A significant number of ecosystems interviewed (53%) also noted they targeted specific groups based on demographics such as race, gender, socio-economic status, or grade (Vance et al., 2016, p. 27).

The next critical factor for success identified by STEM Ecosystems was Educator Capacity. This factor was articulated in building understanding of STEM concepts through professional development training. Ecosystem respondent, however, noted that district policy regarding teacher capacity and autonomy to integrate learning from this

professional development posed a limiter in the effectiveness of these efforts (Vance et al., 2016, p. 29).

A clear and shared vision / mission that directs the work of the ecosystem was the next commonly identified success factor by the participating ecosystems. Ecosystems specifically identified whether their mission was in a commentary, development, implementing, or evaluating phase. Ecosystems that had moved into the developing phase identified the importance of all stakeholders "understands how their organization or them as an individual contributes to reaching those goals" (Vance et al., 2016, p. 34). Though no ecosystems identified themselves in the evaluating phase, 11 did indicate they were implementing common measures across their stakeholders (identified as hubs) to see progress toward the shared goals. They identified that having these common measures even when the individual stakeholders had varying specific interests, presumably as an ongoing commitment to the common mission.

With regard to the factor of Community, inclusive of parents, students, and other members of the public, it was identified as both an area of importance and one that nearly all respondents had less engagement with than other stakeholders. Unlike other sectors, on one of the respondents indicated that this group was enlisted in designing the ecosystem. Efforts to raise parent awareness consisted of two avenues, ways they can support STEM learning at home, and how to navigate existing STEM opportunities with a future STEM career of interest in mind. Inviting stakeholders from across the ecosystem to come be present at public opportunities was identified by some respondents as a way to help raise awareness to the kinds of opportunities available.

The factor of STEM Literacy was unique in that it was not identified by ecosystems in their initial responses to surveys given at the startup of the ecosystem. Defined as "sufficient knowledge of STEM to engage in public discussions on related issues; the ability to be careful consumers of STEM information related to their everyday lives; and the skill needed to enter STEM careers of choice," (Vance et al., 2016, p. 42) ecosystems identified that this as a cross-sector collaboration of in school and out of school time (typically identified as non-profits) with common goals. In addition to aligning programming for common learning, responses noted that cross-sector collaboration of stakeholders helped to build "students' STEM identity" (Vance et al., 2016, p. 43).

The final factor that STEM ecosystems identified as promoters of successful ecosystem development was titled interest. This interest was that of the participating stakeholders. Interest was described by ecosystems for the way that partner organizations see a particular way of aligning their organization with the shared mission of the ecosystem. This was noted as useful to the organization because it may ultimately impact more students and allows the organization to more deeply capitalize on the resources of the broader ecosystem.

Concluding recommendations of the report included developing financial sustainability plans, strategically cultivating the partnerships among ecosystem stakeholders, engaging parents as ecosystem designers, having leaders of the ecosystem take an active role in connecting participating stakeholders to each other and shared resources, as well as managing, organizing, and evaluating those connections. Finally, as

the ecosystem matures, evaluating progression these critical factors and ultimately impact toward the articulated mission.

Responding to Stakeholder Success Values

Diverse Opportunities and Equitable Access

The successful practices reported by pre-and post-survey of existing STEM ecosystems provide an overview to inform ecosystem leadership approaches for growing local ecosystems. These practices largely address the role of leadership in the identified values of collaboration and networking. Two additional values were recognized, diverse opportunity and equitable participation, and community awareness, for which the following provides a review of prior recommendation from the literature.

Diversity and equity in opportunities were two frequently mentioned goals within the family, education, and science centers and museums stakeholder groups. The *Synergies research-practice partnership: a 2020 vision case study* provides a longitudinal view of such practices (Falk et al., 2016) found to positively impact this. The study noted that a variety of factors dissuaded students from interest in STEM. Difficulty in math and science classes in school were exacerbated by the absence of support structures. Moving beyond the K-12 school day as the source of STEM learning, Out of School Time programs and activities have been associated with mediating these negative factors (Allen et al., 2020) and have looked specifically at their interaction within STEM ecosystems. A particularly noted strategy in both the *Synergies* study and in the Allen, Lewis-Warner, et al.'s review was a focus on mentorship (2020). Observing a particular ecosystem from 2017-2018, the Tulsa Regional STEM Alliance made significant gains in participation numbers, mentorship development, and most notably, measures of youth self-reported measures of STEM identity (Allen, Lewis-Warner, et al., 2020).

Out of school time learning opportunities have also been suggested as particularly beneficial because they offer greater freedom in learning opportunities from traditional classroom learning models (Allen, Brown, et al., 2020). Building on the work of anthropologist Edward T. Hall's work on cross-cultural learning patterns, additional recommendations for improving equitable access by diverse learners based on cultural learning norms. Hall's work identified the *Low Context* instructional pattern of traditional academia and *High Context* learning approaches found equally valid and more common in other cultural settings (Chávez et al., 2016; Hall, 1990). Such high context learning includes approaches such as place-based pedagogy, in which the learners have prior knowledge of the environment to which their learning is being applied and using systems diagrams to support learners connecting of specific topics (Weissmann et al., 2019), structures more common in the non-traditional Out of School Time learning environments (Allen, Brown, et al., 2020; Falk et al., 2016).

Raising Community Awareness

A final enduring challenge raised by the Omaha STEM Ecosystem Stakeholders was that raising community awareness was perceived as a key to success. As part of the STEM Learning Ecosystems Discussions Series, a recent webinar brought together STEM Ecosystems to discuss how they are finding ways to support awareness in the success of their ecosystems (STEM ecosystems, 2019). A subsequent summary *Building and Strengthening STEM Learning Ecosystems: A Growing Guide to Success* (STEM ecosystems, 2019) provides guidance in this area.

A recurring theme in the publication was the idea that many positive STEM learning opportunities were occurring in communities, but without an awareness by the

public beyond the participants. "If what you did isn't covered publicly in some way, it's like it never happened" (STEM ecosystems, 2019, p. 5). The webinar addressed topics across organizational consideration including management, communications, governance, programs and initiatives, and fundraising. In each resided elements of the critical importance of relationships with key stakeholders. Building a strong connection with local organizations as a linkage to businesses was identified as a key take away, including Chambers of Commerce, Work-force Development Boards, and Economic Development Councils.

Building on the evidence shown in diversifying participation, ecosystem contributors also encouraged fellow ecosystems to continually take the pulse of the community's needs. In a large ecosystem setting in San Diego, the Fleet Science Center participated in community listening sessions. Approaching from a different lens New York's NYC STEM Network emphasized the need to leverage existing assets recognizing programs already in place within the community and seeking means to scale them (STEM ecosystems, 2019, pp. 8–9)

Lastly, highlighting the work of both organizations within and outside the organization through recognitions of success was identified as a key take away. Even old content might be repurposed, sparking new ideas for its implementation. Whether content was new or old, the importance of purposefully including program providers in the process of how opportunities would be promoted and celebrated were identified as ways that ongoing awareness and interest could be promoted (STEM ecosystems, 2019, p. 5)

Chapter 7: Implications for The Omaha STEM Ecosystem

Chapter 7 was collaboratively authored between Researcher Higginbotham and Researcher Daubert. The final whitepaper is presented in its entirety in Appendix G.

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Appendix A: Lexicon Analysis Tables

Table 4

Initial Document Word and Phrase Analysis for Common Lexicon

Word or Phrase	*n*=count of unique uses	Number of Documents	Definition
STEM	650	49	Science, Technology, Engineering, Mathematics
program	312	40	Stakeholders working with OSE to provide high quality STEM learning opportunities designed to support the STEM workforce pipeline and reduce the existing workforce gap
committee	281	42	Any one of the 6 identified internal committees of the Omaha STEM Ecosystem
ecosystem	210	43	The collaboration of programs in the Omaha area, working strategically address the STEM workforce gap
goal	130	33	A strategically developed set of outcomes aligned to the shared vision STEM education as a tool to reduce the STEM workforce gap.
education	119	29	Formal and informal learning opportunities that enhance the skills of the potential STEM workforce.
evaluation	105	25	Agreed upon measures used to evaluate the impact of OSE's strategic goals, identifying areas of strength and weakness
workforce	90	22	Individuals who possess the skills needed to achieve the business goals of STEM dependent industries.
stakeholder	81	20	All of the individuals and organizations that collaborate through the support of the Omaha STEM Ecosystem
partner	80	16	A distinct group of financial and resource supporters that enable

Word or Phrase	*n*=count of unique uses	Number of Documents	Definition
			coordinated STEM Education in a sustainable way.
communication	79	14	Internal and external mechanisms of stakeholder collaboration and strategic planning.
skill	48	19	Capabilities and talents aligned to meet the goals of organizations within the STEM pipeline
lead/leadership	41	16	OSE's role to connect programs, goals, and learners in opportunities for STEM skill development
collaboration	36	5	Means by which Omaha STEM Ecosystem stakeholders interact to strategically accomplish their shared goals.
collective impact	27	3	Academically significant research on successful means to measure progress toward the strategic goals of the stakeholders of the Omaha STEM Ecosystem.
impact on stem workforce in the Omaha area	24	12	identified jobs that require STEM skills both in Omaha and adjacent communities
high-quality	22	5	Criteria that determine the level to which STEM learning opportunities support the strategic goals of the Omaha STEM Ecosystem stakeholders.
sustainability	21	5	The availability of financial, human, and learning opportunity resources needed to support the strategic goals of Omaha STEM Ecosystem stakeholders.
a database resource of tools	13	7	An accessible collection of STEM learning resources, both physical and organizational, that can be used to meet the shared strategic goals of organizations working together in the Omaha STEM Ecosystem.
the Omaha area	12	3	Those communities within the Omaha City limits and adjacent communities

Word or Phrase	*n*=count of unique uses	Number of Documents	Definition
			that access programs within Omaha as a primary opportunity for STEM learning and career opportunity.
shared framework that evaluates the measurable effects of high-quality STEM programs	8	4	Consensus of measures used to gauge progress toward the goals established to address the social need of STEM workforce gap.
consensus of common language around high-quality STEM	4	4	A shared understanding of terms used to describe STEM programs and their interactions within the Omaha STEM Ecosystem

Table 5

Interview Transcript Word and Phrase Analysis for Common Lexicon

Word or Phrase	*n*=count of unique uses	Number of Documents	Associated Terms
inform	68	26	speak, communication, reach, promote, awareness, communicate, advertise, "inform of STEM opportunity"
involve	103	26	participate, connect, include, together, experience, attend, move, engage, interact, participant, participation, involvement, interact
Omaha STEM Ecosystem	86	26	member, stakeholder, OSE
community	108	22	city, locally, Omaha, metro
Julie	89	22	director, leadership, executive, manage, advisor
email	52	21	
opportunity	99	21	event, program, career, idea, activity, path, direction, initiative
school	70	21	education, educator, teacher, district, classroom, educational, faculty, elementary, K-12, *school name
business	46	17	company
interest	54	17	perspective
science	35	15	
build	37	14	grow, develop, create, design, list, discover, development,
partner	34	14	colleague; partnership
student	53	14	
committee	43	13	team, member, committees, steering committee; research and advocacy committee
resource	23	13	
research	25	12	
website	22	12	online
future	16	11	

Word or Phrase	*n*=count of unique uses	Number of Documents	Associated Terms
engineer	19	10	
evaluation	24	10	evaluate, measure, track, measurement, metric, survey
network	25	10	relate
goal	22	9	focus, purpose, outcome
impact	26	9	engagement
zoo	14	9	
cluster	11	8	cluster, collaborate
conversation	16	8	interaction, discussion
industry	21	8	technology
math	33	8	mathematics
parent	22	8	
skill	12	8	
social	12	8	
teach	21	8	exhibit
university	16	8	college, institution, UNL, MCC, institute
workforce	14	8	pipeline, talent
access	7	7	equity
everybody	27	7	everyone
museum	25	7	
newsletter	9	7	
public	10	7	
response	8	7	
successful	11	7	
youth	8	7	child
advocacy	9	6	
AIM	17	6	
camp	9	6	
phone	7	6	
platform	17	6	portal, directory
relationship	7	6	

Word or Phrase	*n*=count of unique uses	Number of Documents	Associated Terms
challenge	15	5	
girl	18	5	women, women in STEM
knowledge	5	5	
align	15	4	steer, adjust, bridge
club	8	4	
computer	9	4	
conference	7	4	workshop
curriculum	8	4	
design	7	4	
encourage	7	4	
inspire	10	4	
internship	17	4	
invite	4	4	recruit
lexicon	5	4	terminology
nonprofit	17	4	
woman	12	4	
afterschool	4	3	
boy	7	3	
chamber	7	3	
* hospital	4	3	
compete	4	3	
culture	4	3	
expertise	6	3	
foundation	5	3	
manage	6	3	
mentor	4	3	
model	5	3	
speaker	5	3	
strategic	6	3	
the steer committee	6	3	

Word or Phrase	*n*=count of unique uses	Number of Documents	Associated Terms
trust	7	3	
variety	8	3	
confidence	4	2	
database	4	2	
* science center	8	2	
software	4	2	
steam	4	2	
a big pool	4	1	
* museum	8	1	
extension	4	1	
fund	4	1	
manufacture	4	1	
navigator	4	1	
* non profit	5	1	
top of the funnel	5	1	
welder	8	1	

Note: * hidden to maintain interview anonymity

Table 6

Comparison of Document to Interview Lexicon Frequency

Interview Analysis				Document Analysis		
Word combination	Frequency Used	Documents %	Documents Referenced	Frequency Used	Documents %	Documents Referenced
inform	68	100	26	15	23.08	12
involve	103	100	26	19	17.31	9
Omaha STEM Ecosystem	86	100	26	107	55.77	27
community	108	84.62	22	152	44.23	23
Julie	89	84.62	22	171	86.54	45
email	52	80.77	21	24	30.77	16
opportunity	99	80.77	21	76	36.54	19
school	70	80.77	21	82	51.92	27
business	46	65.38	17	105	65.38	34
interest	54	65.38	17	37	36.54	19
science	35	57.69	15	61	19.23	10
build	37	53.85	14	103	46.15	24
partner	34	53.85	14	80	30.77	16
student	53	53.85	14	105	40.38	21
committee	43	50	13	281	80.77	42
resource	23	50	13	53	38.46	20

Appendix B: Coding Books

Table 7

Book of Open Codes

Category	Sub-Category
Programming	Specialization
Committee Membership	
Community	Community Awareness of OSE
Connector-Resource Awareness	Time Working with OSE
What Does OSE Success Look Like	Diverse Opportunities
	Broad STEM Connections
	Central Location for Event Info
	Clearinghouse
	Confidence/Trust in Organization
	Financial Support Provider
	Educator Access
	Equity of Access
	Means of Communicating
	Shared Instructional Approach
	Support for STEM Providers
How Do You Stay Informed of OSE	Community Meetings
	Email
	Expressed Difficulty Staying informed of OSE
	Newsletter
	Personal Contacts
	Social Media
	Traditional News Outlets
	Website
	Trainings and Workshops
How Do You Stay Informed of STEM	Educational Institutions
	Government
	Haven't Stayed Informed of STEM
	Internet Search
	Job Responsibility
	Personal Interaction
	Professional Affiliation-Membership
	Professional Contacts
Why are You Involved with OSE	Donor Expectations
	Interested in Events
	Job Duties
	Value the Mission-Vision
Networking	Collaboration
	Connections-Contacts-Other Organizations
Advocacy	NA

Category	Sub-Category
Silos	NA
Stakeholders	Cross Stakeholder Membership
Too Many Brokers	
Vision	
Workforce	College vs. non-college career pathways
	Pipeline
	Schools/Educators
	Unfilled Jobs
	Keeping Local Talent

Table 8

Book of Pattern Codes and their Open Codes of Origin

Pattern Category	Pattern Code	Pattern Subcode	Detail	Open Code Link
Communication	Formal External Communication	Central location for Event Info	Clearing House (Quality Control)	What does success look like
			Confidence (Trust in OSE)	What does Success Look Like
		Community Meetings - Events		How Do You stay Informed
		Email		How Do You stay Informed
		Julie (Relationship with – contact by)		*New
		Means of Communicating		How Do You stay Informed
		Newsletter		How Do You stay Informed
		Others Connected through profession		How Do You stay Informed
		Social Media		How Do You stay Informed
		Traditional News Outlets		How Do You stay Informed
		Website	Database-Platform	How Do You stay Informed
	Informal – Personal Communication	Others connected through personal relationships		How Do You stay Informed
		Personal Contacts		How Do You stay Informed

Pattern Category	Pattern Code	Pattern Subcode	Detail	Open Code Link
Community Awareness	Community Engagement	Making STEM Inspiring and Approachable		*Originally part of Community but was a single factor
	Educator Access	Shared Instructional Approach		What does OSE Success Look Like
	Interested in Events			Why are you Involved with OSE
	Serving as Broker (Originally termed too many brokers)			*Open Category
Mission, Vision Values	Able to provide financial support			What does OSE Success Look Like
	Broad STEM Connections			What does OSE Success Look Like
	Collaboration			Networking
	Committee membership			*Open Category
	Diverse Opportunities (for STEM learning)			What does OSE Success Look Like
	Donor Expectations			Why Are You Involved with OSE
	Equity of Access			What does OSE Success Look Like
	Job Duties			How Do You Stay Informed of STEM
	STEAM and SEL			* NEW

Pattern Category	Pattern Code	Pattern Subcode	Detail	Open Code Link
	Workforce	College vs. non-college career path		Workforce
		Pipeline	Alignment of Education and Workforce	Workforce
		Schools/Educators		Workforce
		Unfilled Jobs		Workforce
		Keeping Local Talent		Workforce
Networking	Breaking Down Silos – Cross Stakeholder Awareness			Stakeholders / Silos (as an extension of mission)
	Connections – Contacts with other Organizations	Programming	Specialization	Programming
	STEM Resources	Educational Institutions		How do You Stay Informed of STEM
		Government		How do You Stay Informed of STEM
		Difficulty Staying Informed of STEM		How do You Stay Informed of STEM
		Internet Searching		How do You Stay Informed of STEM
		Job Responsibilities		How do You Stay Informed of STEM
		Personal Interaction		How do You Stay Informed of STEM

Pattern Category	Pattern Code	Pattern Subcode	Detail	Open Code Link
		Professional Affiliations - Memberships		How do You Stay Informed of STEM
		Professional Contacts		How do You Stay Informed of STEM
Stakeholder Characteristics	Connector – Resource awareness			* Open Category
	Cross Stakeholder Membership			Stakeholders
	Time working with OSE			*Connector-Resource Awareness
Communication	Formal External Communication	Central location for Event Info	Clearing House (Quality Control)	What does success look like

Table 9

Memo Groups and their Associated Pattern Codes

Memo Group	Associated Codes	Freq Applied
Success = Platform Usage	Formal External Communication -Central Location for Event Info --Clearinghouse (Quality Control) --Confidence (Trust in OSE)	6
Success = Members involved	Networking -STEM Resources --Educational Institutions Formal External Communication -Central Location for Event Info --Clearinghouse (Quality Control) --Confidence (Trust in OSE) Community Awareness -Community Engagement	3
Success = Varied Membership	Formal External Communication -Central Location for Event Info	1
Success = Community Awareness	Networking -Stem Resources -Community Awareness --Community Engagement	21
Success = Workforce Opportunity	Mission, Vision, Values -Workforce --Unfilled Jobs Mission, Vision, Values -Job Duties -Equity of Access -Collaboration	7
Success = Diverse Opportunity	Community Awareness -Community Engagement Community Awareness -Interested in Events	3
Success = Coordinated System	Mission, Vision, Values Networking -Breaking Down Silos	1

Memo Group	Associated Codes	Freq Applied
Success = Collaboration	Communication -Formal External Communication --Confidence (Trust in OSE) -Informal Personal Communication Community Awareness -Community Engagement -Interested in Events Networking -Breaking Down Silos - Connections Contacts with Other Organizations Mission, Vision, Values -Collaboration -Workforce --Unfilled Jobs	15
Success = Networking / Promoting	Networking -Connections Contacts with Other Organizations Mission, Vision, Values -Collaboration Communication -Formal External Communication	5
Success = Diverse Participants	Mission, Vision, Values -Equity of Access Community Awareness -Community Engagement	3
Success = Beyond the Omaha Metro	Mission, Vision, Values -Collaboration Networking	1
Success = Community Values (Places Value on OSE)	Mission, Vision, Values -Equity of Access -Broad STEM Connections	1
Success = Financial Support	Mission, Vision, Values -Broad Stem Connections -Able to Provide Financial Support -Donor Expectations	3

Memo Group	Associated Codes	Freq Applied
Success = Benefits Stakeholder	Communication -Formal External Communication	1
Success = Resource Connection	Networking -Breaking Down Silos Networking -Connections --Contacts with Other Organizations Stakeholder Characteristics -Resource Awareness Mission, Vision, Values -Collaboration Communication -Formal External Communication	11
Success = Keeping Current	Networking -STEM Resources --Educational Institutions --Job Responsibilities --Professional Affiliations – Memberships --Professional Contacts	3
Success = Supports Whole Child	Mission, Vision, and Values -STEAM and SEL Networking -STEM Resources --Personal Interaction --Job Responsibilities	3
Success = Strong Leadership	Networking -Connections and Contacts with Other Organizations	1
Success = Individuals Served	Mission, Vision, and Values -Equity of Access Community Awareness -Community Engagement	3
Success = Business Interest	Communication -Formal External Communication --Central Location for Event Info ---Confidence (Trust in OSE)	2

Memo Group	Associated Codes	Freq Applied
Success = Impact on STEM Opportunities	Mission, Vision, and Values Stakeholder Characteristics Community Awareness -Serving as Broker -Community Engagement Mission, Vision, and Values -Equity of Access	2
Success = Excitement	Networking -STEM Resources --Educational Institutions Community Awareness -Community Engagement --Make STEM Inspiring and Approachable	3
Success = Engaging K-12	Mission, Vision, and Values -Equity of Access Community Awareness -Educator Access -Community Engagement Networking -STEM Resources --Government -Breaking Down Silos Stakeholder Characteristic Mission, Vision, and Values -Equity of Access	5

Table 10

Memo Groups and the Frequency Applied by Stakeholder Group

Memo Group	Freq Applied	Freq Families	Freq Science Centers & Museums	Freq Education
Success = Platform Usage	6	5	0	1
Success = Members involved	3	2	1	0
Success = Varied Membership	1	1	0	0
Success = Community Awareness	21	12	5	4
Success = Workforce Opportunity	7	4	1	2
Success = Diverse Opportunity	3	1	1	1
Success = Coordinated System	1	0	0	1
Success = Collaboration	15	2	9	4
Success = Networking / Promoting	5	1	1	3
Success = Diverse Participants	3	1	1	0
Success = Beyond the Omaha Metro	1	1	0	0
Success = Community Values (Places Value on OSE)	1	0	1	0
Success = Financial Support	3	0	1	2
Success = Benefits Stakeholder	1	0	0	1
Success = Resource Connection	11	1	7	3
Success = Keeping Current	3	0	1	2
Success = Supports Whole Child	3	3	0	0
Success = Strong Leadership	1	0	1	0
Success = Individuals Served	3	1	2	0

Memo Group	Freq Applied	Freq Families	Freq Science Centers & Museums	Freq Education
Success = Business Interest	2	1	1	0
Success = Impact on STEM Opportunities	2	1	2	2
Success = Excitement	3	0	3	0
Success = Engaging K-12	5	0	3	2

Appendix C: Semi Structured Interview Questions

1. Why are you involved in the Omaha STEM ecosystem?

2. When you think of the success of OSE, what does it mean to you?

3. How do you stay informed through the OSE STEM Ecosystem?

4. How else are you staying informed of STEM?

1. Describe how you became involved in the Omaha STEM Ecosystem?

(Follow-up if needed) Do I hear you correctly that _, __, and __ were the reasons why you joined OSE? Anything else you'd like to add?

2. There are a lot of different people and organizations involved in the Omaha STEM Ecosystem. Thinking from your seat, your stakeholder perspective, describe what SUCCESS for the Omaha STEM Ecosystem looks like?

If that stumps the interviewee, rephrase something like "When you think of the success of OSE, what does it mean to you?"

Appendix D: Letter of Support by the Omaha STEM Ecosystem

OMAHA STEM ECOSYSTEM

January 29, 2021

Dear Dr. Williams, UNO Committee, and IRB Team,

As the Director of the Omaha STEM Ecosystem, I am fully supportive of your students' research study investigating the impact of the Omaha STEM Ecosystem on our metropolitan area. Heather Daubert and Garret Higginbotham will collaboratively investigate the shared definition of STEM success within the six stakeholder groups as well as create a shared, consistent STEM vocabulary for the Omaha STEM Ecosystem. This project is very important in providing foundational information regarding stakeholders' common goal as well as the development of a common vocabulary. Using results from this research will allow the Omaha STEM Ecosystem to establish a collective impact process for future evaluation.

The Omaha STEM Ecosystem Research and Advocacy Committee and I look forward to reviewing your findings. If you have any questions, please feel free to contact me.

Sincerely,

Julie Sigmon

Julie Sigmon

3701 South 10th Street Omaha, NE 68107 | (402) 738-2077 | julie.sigmon@omahazoo.com

Appendix E: Invitation/Consent

Dear (Name),

The purpose of this letter is to make you aware of the purpose of the research, process of the study, and any risks or benefits associated with your participation. On behalf of the Omaha STEM Ecosystem the researcher is performing semi-structured interviews with the intent of establishing a shared understanding of success. Interviews will provide an additional resource for qualitative analysis to synthesize the shared and nuanced definition of success for all key stakeholder groups in OSE with the STEM lexicon.

The data you provide through the interview will only be available to the researchers listed on this letter. You will be contacted on email to set up an individual interview via the online platform of Zoom. Data will be used in the doctoral dissertations of researchers Heather Daubert and Garret Higginbotham.

Participation in this study has minimal risks. All of your responses will be kept confidential. Participants may decline to answer any or all questions and can terminate overall involvement at any point during the process. Refusing to participate will in no way impact your relationship with the researcher or the University of Nebraska at Omaha. Should you have any questions about the research, please contact the researcher. Contact information can be found at the bottom of this document.

Please contact the University of Nebraska – Omaha Institutional Review Board through the University of Nebraska Medical Center at (402) 559-6463 for the following reasons:

- You wish to talk to someone other than the research staff to obtain answers to questions about your rights as a research participant
- To voice concerns or complaints about the research
- To provide input concerning the research process
- In the event the study staff could not be reached.

Primary Researcher:
Heather Daubert
Doctoral Candidate
University of Nebraska at Omaha
hdaubert@unomaha.edu

Additional Contact:
Tamara Williams
Chair, UNO Educational Leadership Graduate Faculty University of Nebraska at Omaha
tamarawilliams@unomaha.edu

Your signature indicates that you understand the information in this document and authorize your voluntary participation in this study.

_____ _____ Date: ___/____/____

Printed Name Signature

Appendix F: Invitation/Consent

Dear (Name),

The purpose of this letter is to make you aware of the purpose of the research, process of the study, and any risks or benefits associated with your participation. On behalf of the Omaha STEM Ecosystem the researcher is performing semi-structured interviews with the intent of establishing a shared understanding of success. Interviews will provide an additional resource for qualitative analysis to synthesize the shared and nuanced definition of success for all key stakeholder groups in OSE with the STEM lexicon.

The data you provide through the interview will only be available to the researchers listed on this letter. You will be contacted on email to set up an individual interview via the online platform of Zoom. Data will be used in the doctoral dissertations of researchers Heather Daubert and Garret Higginbotham.

Participation in this study has minimal risks. All of your responses will be kept confidential. Participants may decline to answer any or all questions and can terminate overall involvement at any point during the process. Refusing to participate will in no way impact your relationship with the researcher or the University of Nebraska at Omaha. Should you have any questions about the research, please contact the researcher. Contact information can be found at the bottom of this document.

Please contact the University of Nebraska – Omaha Institutional Review Board through the University of Nebraska Medical Center at (402) 559-6463 for the following reasons:

- You wish to talk to someone other than the research staff to obtain answers to questions about your rights as a research participant
- To voice concerns or complaints about the research
- To provide input concerning the research process
- In the event the study staff could not be reached.

Primary Researcher:
Garret Higginbotham
Doctoral Candidates
University of Nebraska at Omaha
ghigginbotham@unomaha.edu
Additional Contact:
Tamara Williams
Chair, UNO Educational Leadership Graduate Faculty University of Nebraska at Omaha
tamarawilliams@unomaha.edu

Your signature indicates that you understand the information in this document and authorize your voluntary participation in this study.

_____ _____ Date: ___/____/____

Printed Name Signature

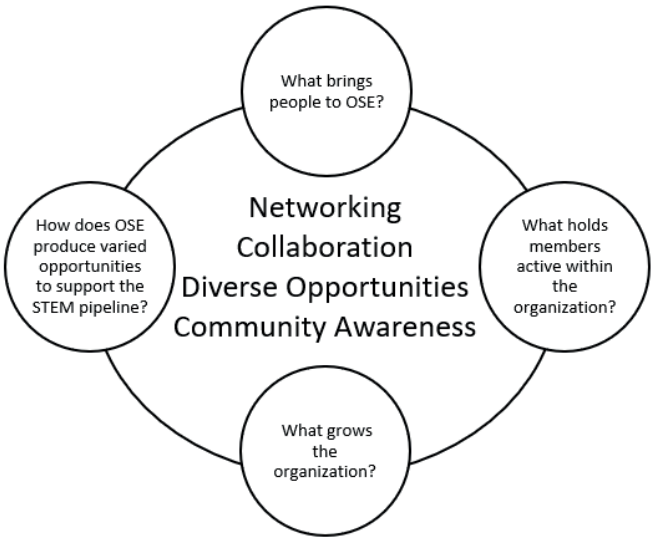
Appendix G

Theory of Success

Created for Omaha STEM Ecosystem

August 2021

By Garret Higginbotham and Heather Daubert



The collective voice of all stakeholder groups concludes that through Networking, Collaboration, Diverse Opportunities, and Community Awareness, OSE will foster success by bringing people to the organization, holding them active, growing the participation, and producing varied opportunities which support the STEM pipeline.

Established in 2016, the Omaha STEM Ecosystem (OSE) is a multi-stakeholder collaborative network (MSCN) with active members from six key stakeholder groups: Business, Government, Non-Profit, Education, Families, and Science Centers & Museums. This paper synthesizes the shared and nuanced understanding of what success means for OSE by all six key stakeholder groups. This theory of success describes the stakeholders' perspective of the value of what they gain from membership in OSE as well as how OSE fosters this shared value to all members. Thus, as a responsive organization, it is recommended OSE continue to align their future development with the OSE Theory of Success presented in this paper.

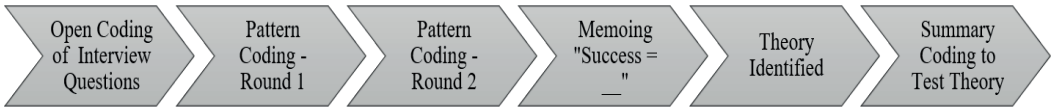
Background

The Omaha STEM Ecosystem (OSE) serves as a connecting agency to leverage the social capital of member stakeholders to address the STEM workforce gap by strengthening the availability of STEM pipeline learning opportunities. OSE seeks to bring diverse stakeholders from multiple sectors of the community together to promote high-quality STEM learning opportunities that will address the current and future workforce gap associated with STEM skill sets (Omaha STEM Ecosystem, 2019). In 2021, as OSE approached its 5th year of supporting this mission, it sought to evaluate its impact. Co-researchers Heather Daubert and Garret Higginbotham, in coordination with the Omaha STEM Ecosystem's Research and Advocacy Committee, began dialogue to perform a Collective Impact Evaluation for the organization. In studying the lifecycle of Multi-Stakeholder Collaborative Networks (Roloff, 2008), it was determined that the Ecosystem was yet in a *building* capacity of its operation and additional input was needed from stakeholders to determine what criteria by which to claim evidence of success.

Process

1. Researchers created the Omaha STEM Ecosystem (OSE) STEM Lexicon. This lexicon list of words and phrases was derived from content found in OSE internal and public-facing documents and content on the OSE website. It was important to create the OSE STEM Lexicon because when a multi-stakeholder collaborative network (MSCN) comes together without an agreed-upon common vocabulary, by default, each member will apply individual definitions based on personal experiences and biases.
2. Researchers interviewed members of all six key stakeholder groups. A total of 26 interviews were conducted in the spring and summer of 2021. Semi-structured interviews consisted of 4 key questions (1) Why are you involved in the Omaha STEM ecosystem? (2) When you think of the success of OSE, what does it mean to you? (3) How do you stay informed through the Omaha STEM Ecosystem? (4) How else are you staying informed of STEM? Participants were allowed to elaborate to maintain an open dialogue. The robust interview results were coded through many stages. The OSE STEM Lexicon was used in the first stages of coding.

Coding Methodology



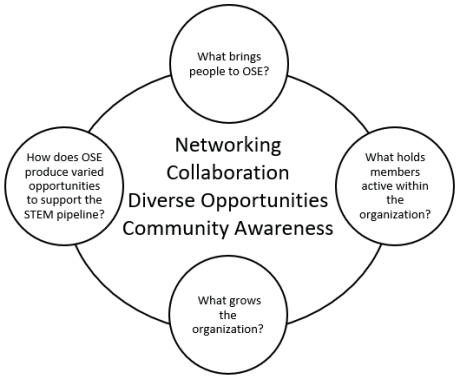
Each of the six stakeholder groups described the value-add and success of OSE from their stakeholder perspective in several ways including Networking, Collaboration, Diverse Opportunities, and Community Awareness.

Percentage of Interviews in Which Success Factor Codes Were Present

Stakeholder Group	Collaboration	Community Awareness	Diverse Opportunities	Networking
Education (4 interviews)	75%	100%	100%	75%
Families (5 interviews)	40%	100%	60%	0%
Science Centers and Museums (5 interviews)	40%	80%	80%	100%
Business (4 interviews)	25%	100%	75%	75%
Government (4 interviews)	75%	100%	75%	50%
Non-Profit (4 interviews)	25%	50%	100%	75%

3. From the qualitative analyses, researchers identified a theory of value-add success for OSE. This OSE Theory of Success describes the stakeholders' perspective of the value of what they gain from membership in OSE as well as how OSE fosters this shared value to all members. Thus, as a responsive organization, it is recommended OSE continue to align their future development with the OSE Theory of Success. To do so, OSE will continue to reflect and program using the outer four questions in order to achieve the inner four components of shared success.

Theory of Success for Omaha STEM Ecosystem



Following is additional context and recommendations for each of the four components of value-add success: Networking, Collaboration, Diverse Opportunities, and Community Awareness. Recommendations are a synthesis of the interview results and best practices communicated in current literature.

Networking

Networking leads to trusting relationships and collaboration. Events which encourage networking and collaboration bring stakeholders together and are more likely to support the growth of OSE and future STEM-related opportunities for the community (Bryson et al., 2006).

Presence Within the Stakeholder Interviews

In analyzing the responses of the interviews, we found that the strongest focus on networking came from Science Centers and Museums. Specifically, they referenced wanting to connect their patrons and their staff with businesses and nonprofits to help provide real world linkages to exhibits presented in the museum. Education, Business, and Non-Profit stakeholders had a secondary level of interest in networking with Business and Non-Profit stakeholders having a greater emphasis on connecting with other stakeholder groups, co-promoting and complementing individual programs they currently

operate, and having some alignment with the values expressed by Science Centers and Museums in seeking contacts to provide context and application to existing programs offered in schools. Absent from a networking presence was the Family stakeholder group. The researchers interpret that a family conceptualization of networking falls more in-line with the Community Awareness construct of success.

What the Literature Suggests

Networking opportunities help foster partnerships which, without a prior relationship or connection, would otherwise be slow to form (Gibson et al., 2014). As people connect, relationships form which leads to safe places to express ideas and opinions (Kezar et al., 2017). When the relationship is new, stakeholders will rely on those individuals from prior relationships and networks to judge the trustworthiness of others involved (Bryson et al., 2006). Informal networks increase professional satisfaction and performance (Cross, et al., 2002), and establishing personal connections leads to peer-to-peer learning, opportunities to follow up and brainstorm about collaboration, and mentoring (Kezar et al., 2017).

Networking can serve as an early connector for the larger organization because it benefits each individual stakeholder as well as the larger multi-sector collaboration. Easterling et al. (2013) suggests that by bringing individuals and groups together in joint meetings to get to know one another and learn about one another's programming, there will be a short-term, immediate benefit for the consumers of the stakeholder-led opportunities, but not a long-term effect. This is where it is critical for an ecosystem to bring individuals together to network and create strong relationships so that the

organization can move to include collaboration and varied opportunities for stakeholders and their consumers.

Gibson et al. (2014) note that when agencies engage in collaboration to share both ideas for implementation and to align the individual services they provide, they are likely to better meet the needs of the consumer. This aligns with the Omaha STEM Ecosystems value of reducing silo- based implementation of STEM Learning by establishing connections and the opportunity for a continuum of STEM Experiences.

Implications

- continually recruit new members (and the ideas they bring) into the different stakeholder groups (Allen, Lewis-Warner, et al., 2020)
- provide regular networking opportunities for members and interested individuals
- serve as an active connecting agent amongst stakeholders based on common interests and needs

Collaboration

As the Omaha STEM Ecosystem fosters cross-stakeholder relationships, their next opportunity to sustain their members and organizations is in helping to establish meaningful collaboration. Collaborative partnerships within the network establish common goals, share resources, and develop social capital. In so doing, collaborations help balance risks and strengthen trust to facilitate the pursuit of common goals.

Presence Within the Stakeholder Interviews

The strongest presence for collaboration as a success factor was presented by Education stakeholders and Government stakeholders. The coding indicated that Education stakeholders had a resource-based emphasis on collaboration with other

stakeholders. They saw collaboration as a means to access and share resources that might enhance STEM learning but were beyond the scope of their ability to acquire individually. Government stakeholders saw OSE as the place where organizations with similar activities could connect and synergize. Through sponsorship, outreach, and support, they advocated for partnering and creating a coordinated system that brought multiple stakeholder groups together for a united purpose. The researchers also identified that Non-Profit and Business stakeholders identified success through collaboration to a lesser degree than others. The literature offers some suggestions to this relationship.

What the Literature Suggests

To have a long-term impact, the group will go beyond sharing ideas, and instead, come together to find gaps and replications, then create and expand opportunities from there (Easterling et al., 2013, p.106). Eventually new norms and processes may form. This will result in less disconnect between stakeholders and a joining together of new ideas and actions (Bryson et al., 2015; Clarke and MacDonald, 2019). Through open, consistent communication and checkpoints, executive leaders can assess and suggest adjustment with the collaborative initiative as needed (Cross et al., 2002).

Trust generates collaboration, and according to Yin and Jamali (2020), collaboration generates value. “Developing trust and getting to know people is critical if STEM communities of practice are going to provide advice in the future and eventually become mentors” (Kezar et al., 2017, p. 233). You can have a well-managed organization, but without trust, it will likely not be a cooperative one. A well-connected teammate can help develop trust within the bigger organization (Bryson, 2006; Gibson et al., 2014). In a collaborative organization, ongoing trust building activities are essential

(Asera et al., 2017; Bryson et al., 2006; Kezar et al., 2017; Warsen, et al., 2018), but trust can be maintained during times of inactivity as long as there was trust before the pause (Davis, 2016). A lack of communication and misunderstanding of another partner's goals can erode trust and data sharing (Regional Educational Laboratory Program West, 2017).

Implications

- initially prioritize impacts on stakeholder experiences over impacts on the broader organization
- consider small projects for big wins with trust-building and collaboration
- allow stakeholders to participate flexibly as commitment is developed
- facilitate ongoing communication within and between the stakeholder groups
- maintain regular check-ins between committee leadership and the executive committee
- allow time for collaborations to move from networking to joint learning and innovation

Diverse Opportunities

Given the Omaha STEM Ecosystem's goal to strengthen the STEM pipeline, providing diverse opportunities represents a critical factor in building upon the strength of organizational stakeholders and increasing participant stakeholders' access to relevant STEM learning. As diversity represents a broad yet salient social value, it is important in leveraging its success to consider the way in which it manifests within the OSE STEM Lexicon.

Presence Within the Stakeholder Interviews

The researchers' coding of interviews found that the stakeholders who focused most on Diverse Opportunities were the Education stakeholder group and the Non-Profit stakeholder group. Science Centers and Museums additionally had a strong, though lesser presence of this factor of success. Application of the code was primarily to recognize a variety of kinds of learning opportunities also conceptualized as a variety of ways to learn and progress the sophistication of STEM Skills. Though a lesser emphasis toward success, a secondary interpretation of Opportunity Diversity held an equity lens that was also present in the Community Awareness success factor. This emphasis was on geographic diversity of opportunities, breaking down structural barriers to participation such as location, and supporting equity of access across traditionally underrepresented participant groups.

What the Literature Suggests

Literature regarding diversity of STEM opportunities hints to both advantages and challenges. A diverse group of members may lead to a varied vernacular and priorities. Members are likely to gravitate toward individuals and organizations who share a similar lexicon and working style. This makes it easier in the initial phases, but more difficult for the bigger communication between the different stakeholder groups (Cross et al., 2002; Reypens, Livens, and Blazevic, 2016). Establishing a common lexicon across the organization facilitates communication and opportunity to create more diverse offerings (Reypens, Livens, and Blazevic, 2016).

While consensus may be more challenging to achieve, bringing together a diverse group of stakeholders encourages a more realistic view of the problem, and a better sense of the local context (values, politics, assets) surrounding it. Members are more likely to

challenge the generally accepted way of doing something and better able to see the bigger picture (Easterling et al., 2013; Hearld et al., 2019; Kezar et al., 2017). By remaining open-minded to new ideas, values, and viewpoints, the group is more likely to move towards innovation and possible solutions (Davis, 2016; Hearld et al., 2019; Irfan, 2021; van Tulder et al., 2016; Washbourne et al., 2020).

In terms of ensuring diverse opportunities for students, a cross-sector collaboration should prioritize growing *interest* in STEM-related activities, particularly of students in the early adolescent years (Falk & Dierking, 2018; Falk et al., 2016; Maltese and Tai, 2011). Traphagen and Traill's (2014) working paper *How Cross-Sector Collaborations are Advancing STEM Learning*, suggests STEM learning ecosystems can support STEM interest by establishing multiple touchpoints across a variety of learning spaces, including schools, after school programs, science centers, at-home discovery, summer experiences, and exposure to adults within a child's family and peer groups. Participation in these spaces increases exposure and encourages children to engage and become more knowledgeable regarding STEM (Falk & Dierking, 2018; Falk et al., 2016, Morrison and Fischer, 2018; Traphagen and Traill, 2014).

Leveraging diversity of opportunities to draw additional participants was also noted as a significant benefit in the *Synergies research-practice partnership: a 2020 vision case study* (Falk et al., 2016), by focusing on interest-based, STEM learning in an Out of School Time (OST) program which was seen to provide a diverse context from the traditional school setting. Diverse role models will also allow participants to see opportunities for their own future STEM learning through structured mentorship (Falk et al., 2016). By seeking input from all participants and expressing value in their responses,

stakeholders are better equipped to shape activities to match student interest, including a direct time for students and fellow stakeholders to meet with mentors for discussions on careers and how to get there (Kezar et al., 2017).

Implications

- ensure OSE provides unique resources to facilitate access to STEM opportunities
- assist individuals and organizations in securing funding for equitable access and participation
- actively connect with stakeholders to remove barriers to participation
- seek to partner with existing mentorship programs or develop their own network of STEM mentors
- ensure internal committees are composed of individuals from diverse professional backgrounds and demographics

Community Awareness

At its core, community awareness represents the Omaha STEM Ecosystem's goal to serve as a source for both identifying high quality STEM experiences and a resource for individuals and organizations seeking access to those opportunities. Success for the Omaha STEM Ecosystem occurs in actively bringing its stakeholders together through these elements of mutual trust.

Presence Within the Stakeholder Interviews

In analyzing the responses of the interviews, the researchers found that Community Awareness was the strongest focus amongst the combined stakeholder set. Furthermore, it was present in 100% of the interviews across the Education, Family, Business, and Government stakeholder groups. Analysis of the codes identified two sides

of trust for successful Community Awareness, 1) Trust by STEM learning providers that OSE will help to bring participants, and 2) Trust by participants that OSE will actively help them locate opportunities that would meet their needs and interests. Interviews from both the Education and Family stakeholder groups wanted an easy way to find opportunities and an easy way to understand where in the learner's continuum of STEM skill the opportunities would align. Stakeholders from Business and Government carried a greater focus on the return on investment for their support of STEM learning opportunities toward creating a STEM proficient workforce pipeline.

What the Literature Suggests

Raising awareness of opportunities for STEM Learning beyond the scope of existing stakeholders and participants has posed a challenge for STEM Ecosystems across the country. As part of the *STEM Learning Ecosystems Discussions Series* webinar leadership of several large ecosystems discussed (STEM ecosystems, 2019), a subsequent summary *Building and Strengthening STEM Learning Ecosystems: A Growing Guide to Success* (2019) provides recommendations for ecosystems. Recommendations largely focused on effective communication skills such as a consistent and predictable modes of sharing the work, opportunities, and success occurring within the ecosystem's network of stakeholders, making plans for how to communicate an integral part of event and learning activity planning, and engaging in active solicitation of feedback both from current participants (STEM ecosystems, 2019) and the community to align offerings with expressed community needs and interests (Vance et al., 2016).

"Finding creative and meaningful ways to engage public audiences is a hallmark of informal STEM education" (Allen & Peterman, 2019, p. 31). By maintaining a heavy

social media presence, producing op-eds, speaking at forums, and sending press releases, ecosystem stakeholders have the opportunity to provide multiple opportunities for the community to hear the ecosystem's name and purpose. Ecosystems can also gain credibility by promoting the work of the different partners within the ecosystem. Not only does this build good faith within the ecosystem, but it gets the ecosystem's name out in the community and tied with another well-known organization without having to create specific content with it (STEM ecosystems, 2019).

Implications

- actively leverage stakeholder relationships to expand OSE's name recognition and public presence within the community
- coordinate strategic communication practices with stakeholders providing STEM opportunities
- plan the publicity associated with the event alongside the activity itself
- continue to develop OSE's brand as a recognized and trusted connector to STEM opportunities
- maintain a pulse on public STEM interest and strategically act to address workforce gaps

Next Steps

Having identified a commonly used lexicon, factors of organization success, and a theory of implementation, the Omaha STEM Ecosystem is positioned to pursue a next phase in its organizational life cycle (Roloff, 2008). Stakeholder interviews identified formative measures by which the organization could gauge its current progress with networking, collaboration, diverse opportunities, and community awareness. By

applying the lexicon which emerged from both organizational communication and stakeholder voice, the organization now has the opportunity to identify agreed upon measures for ongoing impact evaluation.

The Omaha STEM Ecosystem is already engaged in active opportunities for stakeholder feedback through community roundtables. One question to consider may be if participation in those roundtables represents the diversity of views and perspectives that stakeholders encouraged and the literature suggests would help to grow local STEM learning participation. Such diversity will likely factor into future measures of impact based on participation and the satisfaction (or level of interest/engagement) of participants which leads them to return.

Furthermore, in building upon the framework of bringing participants, holding members, growing the connections within the organization, and producing varied opportunities, OSE will likely wish to consider what measures represent a quantifiable approach and what measures represent a quality of experience. The literature and interviews suggest that both are important to the stakeholder network. Though not discussed in this review, the researchers recognize that OSE has developed tools by which stakeholders can self-evaluate their role in the ecosystem. The literature also provides examples where other ecosystems have adopted common measures of impact as a part of their own lifecycle as a Multi-stakeholder Collaborative Network (Allen, Brown, et al., 2020; Allen, Lewis-Warner, et al., 2020; Falk et al., 2016; Vance et al., 2016).

Finally, as the Omaha STEM Ecosystem continues to execute its strategic plan and develop its formal business plan, the researchers recommend using the developed Theory of Success for continued planning and progress monitoring. Continued

awareness of stakeholder perspectives can assist the organization in targeting partnerships, strategically targeting communication, and playing an active role in influencing the growth of STEM learning opportunities.

Further Reading:

For further details and analysis, please see the working dissertations of Heather Daubert and Garret Higginbotham, available upon request or future publication.

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