Formula for Success for Interdisciplinary Initiatives

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Background

The open-ended and ill-defined nature of today's challenges [1] requires students with the ability to work both within and outside of their own discipline [2], [3] by integrating knowledge and skills from various fields [4]. Most academic and research institutions often operate in silos rather than in organizational structures that facilitate learning and discovery across disciplines. Interdisciplinary research and education have been recommended as an approach to tackle such problems [5], [6]. Thus, universities have been moving towards interdisciplinary research and education by creating institutions and hubs [7], [8]. These new initiatives have been supported by students, politicians and federal research granting agencies who want to see more interdisciplinary research, innovation, and educational programs across traditional disciplinary lines [9]. However, there is a wide spectrum regarding the level of success for these interdisciplinary initiatives. The goal of this study was to gain insight from experts who have been involved with the development, implementation, and operation of interdisciplinary initiatives. The focus was the examination of key factors for success and the development of a model which can be used to improve the outcomes for existing initiatives and assist in the planning and development of new ventures.

Multi vs. Inter. vs. Transdisciplinary

In this work, a very broad definition of Multi/Inter/Trans disciplinary approach was used. Throughout the interviews, participants were not corrected on the use of the terminology as the interview transcripts were coded and interpreted by the researcher. Throughout this report the term interdisciplinary will be used to encompass all types of collaborative work. However, the definition of Multi/Inter/Trans Disciplinary approaches and their application in education are provided below. Figure 1 illustrates how different disciplines and partners are integrated and the type of outputs produced by each approach.

Multidisciplinary includes knowledge from a wide variety of disciplines while retaining each discipline's individual identity [3]. In other words, it lacks the integration between fields and disciplines [10]. Multidisciplinary learning and teaching include an opportunity for students to learn about multiple disciplines related to a topic, with no synthesis or integration [11].

Interdisciplinary on the other hand requires integration between different fields and conceptual synthesis [12], [13]. The integration between knowledge and disciplines allows one to address problems which cannot be addressed using a single discipline [14].

Transdisciplinary not only includes the integration of two or more disciplines but also involves collaboration with external stakeholders [3], [15]. "Integration becomes the purpose of education, not simply a tool. In student-centered curricula, the student's world becomes the heart of learning" [13].

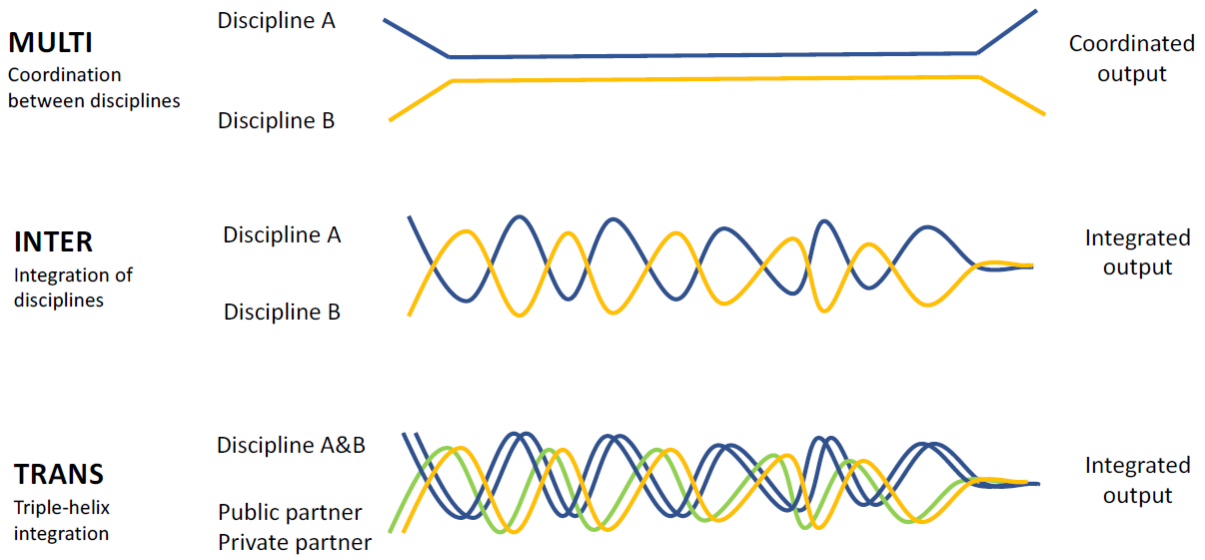

Figure 1: Multi/Inter/Trans Disciplinary Approaches, (Modification of Keestra [16])

Methodology

This study involved interviewing four Directors from different University based interdisciplinary initiatives across North America. Throughout this paper the term "interdisciplinary initiative" will be used to describe both research, industry and educational collaborations. Approval to conduct the study was obtained from the General Research Ethics Board (GREB) at Queen's University. The interviews consisted of nine questions as outlined below.

1. How did your interdisciplinary initiative originate and how was the area of focus selected?
2. What is your definition of a successful interdisciplinary initiative?
3. What do you consider to be the key factors for success in a interdisciplinary initiative? Do these change over time (i.e., short, medium and long term).
4. How do you measure success within your institute, and what metrics do you use to track progress and evaluate the impact?
5. How important are industry partnerships and collaborations for the success of your institute?
6. What are the best practices for attracting research funding, specifically multidisciplinary grants?
7. How do you attract top talent, both internally and externally, to participate in the efforts of the multidisciplinary institute?
8. How do you develop and design academic programs and courses that align with the goals and priorities of your multidisciplinary initiative?
9. What challenges do you anticipate facing in the coming years, and how do you plan to address these challenges to ensure the continued success of your institute?

Interview Question 3 asks about key factors for success and adds a temporal element to the discussion. During the interview participants were shown the mind-map illustrated in Figure 2 and asked to indicate which factors were most important during different stages of the life span of an interdisciplinary initiative. Based on the researcher's experience developing and participating in interdisciplinary initiatives, the illustration shown in Figure 2 was created as an interview aid to help start the discussion on key factors. The study participants used Figure 2 to focus on key factors and identify missing factors.

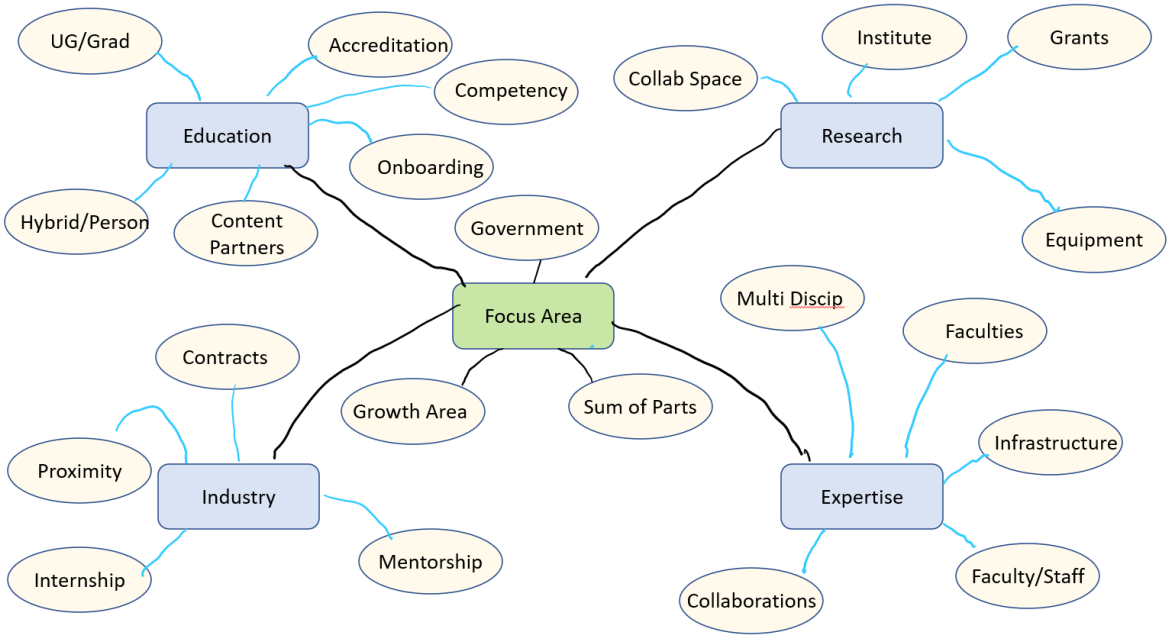

Figure 2: Interdisciplinary Success Factors

Thematic analysis was done to analyze the semi-structured interview data [17], with insight from coding methods suggested by [18]. Two members of the research team coded the first interview separately using a combination of in-vivo coding, sub coding and descriptive coding [18]. The researchers then discussed code definitions, agreed on the coding of the two transcripts, and developed an initial code book. This process was repeated for all four transcripts with the codebook being revised after each round of coding. Similar codes were then grouped together to develop sub-categories and categories [18]. Upon analysis of the coding and examination of the categories, several possible models were developed to highlight the key information garnered from the interviews. The researchers' intention was to develop a model that displayed the intricacy and relative importance of the various factors identified by the Directors, while also having a form that is easy to understand and represent graphically.

Formula

After reviewing the code book and examining the various categories a formula for success for interdisciplinary initiatives was created as shown in Equation 1.

$$Formula\ for\ Success = [\Pi\ Foundation][\Sigma\ Synergy]^{Integrative\ Field} \quad \text{(Equation 1)}$$

The formula has three main components. A group of foundational variables that multiply together to form the "Foundation" term, a set of factors that add together to create the "Synergy" term and the "Integrative Field" which is the exponent. Figure 3 was developed to provide a graphic which describes the components of the formula and illustrates the trajectory of a successful initiative.

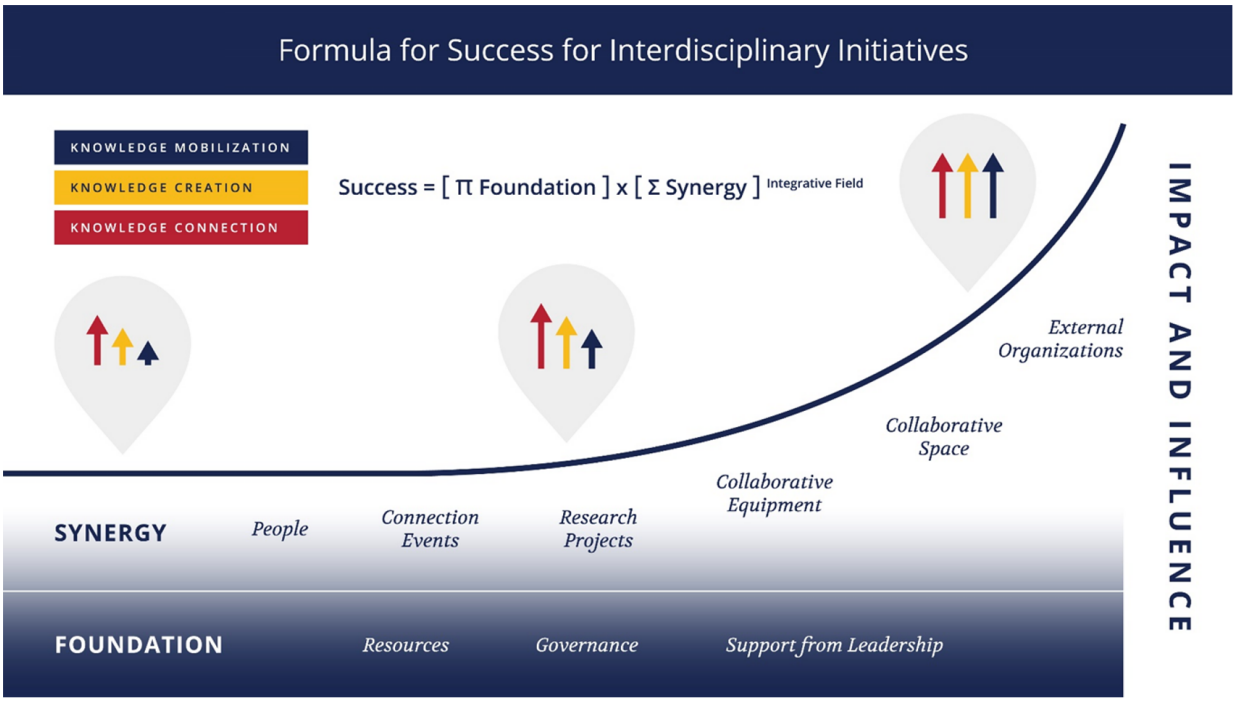

Figure 3: Formula for Success for Interdisciplinary Initiatives

Exponent

One of the key drivers for successful interdisciplinary initiatives is the integrative field that is selected. During our interviews the directors focused heavily on how to pick a desired field and the importance of key aspects of the selection. Growth was a term that was repeated throughout the interviews. Selecting a field that has a substantial amount of space for growth both in depth and breadth is important for sustained success. Several of the Directors came from interdisciplinary initiatives focused on artificial intelligence, machine learning and data science. They used these integrative fields as examples of areas with substantial growth potential. This growth is not limited to strictly the technical developments that come from research collaborations but rather more broad topic areas which have societal impact. Artificial intelligence is a good example as it is experiencing exponential development on the technical side but also in its applications across society. These types of Integrative fields provide room for growth as well as space for pivoting within the field.

The selection of the disciplines working in the integrative field is also vital to success. The key is enabling individuals from different disciplines to work interactively to solve problems and

innovate within the selected field. An example of a good integration is engineering and business working on blockchain and financial technology. This area requires complete integration of expertise from these two disciplines to develop new ideas and solutions. One Director described the selection of the integrative field as "*Emerging and will be impacting (society), almost cutting across disciplines. A Big umbrella where people can have flexibility to create their own world."*

As seen in Equation 1 the integrative field term is in the exponent. This means the degree to which integration occurs and the nature of the selected field can combine to be the engine for exponential outcomes.

Foundation

Through the interviews we identified several key factors that act as a foundational layer for successful interdisciplinary initiatives. These foundational factors do not contribute directly to the exponential impact that can be realized from interdisciplinary collaborations. However, these factors are essential and if not in place the initiative tends towards failure. The three foundational factors that were identified include support from leadership, governance, and resources. In the formula for success these individual factors are combined into the Foundation variable in Equation 1. If this variable is expanded, it can be illustrated as the multiplicative product of the three identified factors as seen in Equation 2. Therefore, if any factor is not present or zero, then the Foundation variable and the overall formula goes to zero.

$$\Pi\, Foundation = (Resources)x(Governance)x(Support\ From\ Leadership) \quad \text{(Equation 2)}$$

On the other hand, if these individual factors exist then they combine to form a very strong foundational basis for the interdisciplinary initiative. This strong foundation can act as a springboard towards overall success. However, as seen in Equation 1, the Foundation variable is not included in the term that is influenced by the exponent. This means that exponential growth and success of an interdisciplinary initiative can't come solely from having support from leadership, resources or a strong governance structure.

Support from leadership

Almost all novel initiatives require support from senior leadership to be successful. This support is even more paramount for interdisciplinary initiatives due to the structure and combination of multiple disciplines. The majority of organizations that participate in interdisciplinary initiatives are usually structured in functional organizations. For example, in higher education the different disciplines come from faculties where the operational units are usually departments that specialize in a specific field. In engineering all our departments would fall under Smith Engineering. This is typically the same structure in medicine, business and the arts, a hierarchical structure focused on functional groups where the resources and reporting flows along functional lines. This structure can act as an obstacle to interdisciplinary initiatives. Since, any resource allocations towards an interdisciplinary initiative can negatively impact the resources for the functional groups' main mission. This is a large and sometimes unsurmountable obstacle to overcome. The best way to navigate this obstacle is to ensure support from leadership.

Given the increased focus on interdisciplinary initiatives it is not hard for senior leadership to justify the development of these collaborations based on direction from government, granting agencies and society. However, for interdisciplinary initiatives to succeed on a local level it is vital that senior leadership show support and even incorporate these types of initiatives into their vision. One participant in the study outlined how senior leadership support had changed since taking over as Director. Earlier leadership was focused on developing these types of interdisciplinary programs and adequately recognizing and resourcing these initiatives. However, with a change in leadership this support dissolved and so did the recognition and resources to support the initiative. This lack of leadership support hurts the initiative and can cause it to fail. The opposite is also true that firm support from leadership can provide a strong base for the new initiative and allow participants to focus on other key factors in the formula, since they know they have leadership support.

One Director during the interview touched on the fact that sometimes you can have outwards support from leadership, since interdisciplinary initiatives are a focus right now. But the support needs to be complete both in external communication and through internal resources *"I don't have support. People talk that they're supportive, but actually, their actions (are the opposite)"*. The Director indicated that this lack of true support could result in the demise of his program.

Governance

Governance was not one of the factors for success that we had identified in the mind map in Figure 2. However, almost all our participants identified some form of governance and policy as a key factor for the success of interdisciplinary initiatives. For research-based institutes the directors discussed key governance policies and procedures including how resources are shared and distributed as well as the onboarding process for new members. They considered these policies to be an essential foundational aspect. Without these policies there can be infighting and competition within the organization. This erodes collaboration and synergy and has a detrimental effect on the overall initiative. Therefore, without these documented governance structures the overall initiative can move towards failure. It is also true that governance is not a catalyst towards exponential growth. The governance documents and structure just need to be in place for the initiative to be successful and not overly restrictive. One Director outlined governance as *"We quickly realized, after we got people together that we needed to have some governance, and we needed a way to regulate who is coming in and out... it isn't super specific, ... it leaves room for interpretation."*

For interdisciplinary educational initiatives governance was focused on accreditation. The Directors for these programs focused on ensuring that there was an accreditation process that evaluated the program. Finding an accreditation body for interdisciplinary initiatives can be difficult but directors felt that it was an essential foundation for success.

Looking at Equation 2, governance fits well into the foundational variable. If there is a lack of governance structure within an initiative this variable tends towards zero and results in failure of the overall initiative. If there is sufficient governance structure, then the variable becomes a

whole number. This number is not large and does not play a role in the heights that an interdisciplinary initiative can reach in terms of impact and influence, but it is a foundational factor.

Resources

Resources are vital to the success of any new initiative, and this was voiced by numerous Directors that we interviewed. Some interdisciplinary initiatives had started from large philanthropic donations while others were more organic starting from a small grant or collaboration between colleagues. Like governance and support from leadership, without resources the initiative can tend towards zero. Intuitively one would think that resources would contribute to exponential growth within an initiative. However, the Directors felt that no matter how large the number of resources thrown at a project, without synergy there is little chance of true success. This is why it is part of the foundational factors in the model. Furthermore, the Directors recognized the importance of acquiring monetary resources but were more focused on acquiring resources that could help fuel synergy. For example, one director was very focused on having time spent teaching in the interdisciplinary initiative count towards a faculty member's teaching load and service. This resource allocation would allow members to dedicate more time and effort towards the interdisciplinary initiative. Without these types of resources members are too busy with other work to contribute to the sustainability and growth of the initiative.

Synergy

Synergy is the combination of all the collective efforts and integration of an interdisciplinary initiative. Figure 4 provides a graphical representation of all the aspects that are included in Synergy. As seen in Figure 3 synergy can also be represented mathematically as the area under the curve. On an operational level it can be seen as the sum of the tactical level components shown in Equation 3 such as people, connection events, research projects, collaborative equipment, outside organizations. These elements are additive and together form the key variable that is acted upon by the exponent. Synergy can also be seen as a recombination of the operational elements to the more strategic view of knowledge connection, knowledge creation, knowledge mobilization shown in Equation 4.

$$\Sigma\,\text{Synergy} = People + Connection\ Events + Research\ Projects + Collaborative\ Equipment + Collaborative\ Space + External\ Organizations$$

(Equation 3 – Tactical Level Synergy)

$$\Sigma\,\text{Synergy} = Knowledge\ Connection + Knowledge\ Creation\ + Knowlege\ Mobilization$$

(Equation 4 – Strategic Level Synergy)

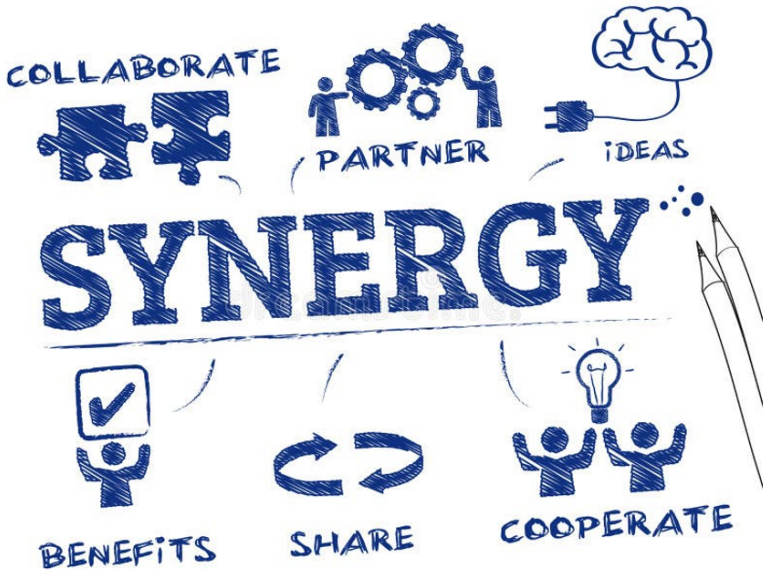

Figure 4: Aspects of Synergy (https://www.shutterstock.com/search/synergy-chart)

Operational Level

People

It was unanimous during the interviews with the Directors that people are a key aspect for success and contribute to the synergy of the initiative. The focus was not necessarily on the number of people involved in the collaboration but rather the type and qualities of the people. The Directors commented that they require open-minded individuals who have a good knowledge of their domain to share with collaborators but also the ability to work on the intersections. One director indicated that the edges and intersections are the area where interdisciplinary initiatives can thrive:

" […] people are continuously learning from each other, and using that to expand the scope of what they can do because there are people who can move towards the interfaces. So you know the expression, the opportunities are at the interfaces. And it's the interfaces between the disciplines where the impact happens."

This also means that you don't necessarily need the world's expert in a certain area to be successful in interdisciplinary studies. What is considered more important is a person's ability to make connections between their domain knowledge and others within the collaboration:

"I mean, I think you need to have the people who can engage in the conversation. You don't have to have the top expert, but enough expertise to understand what you are missing and what your strengths are."

Connection Events

In order to build synergy, it is vital that knowledge be shared between members of the interdisciplinary initiative. The broadening of an individual member's understanding of a topic and potential application is key for innovation in the integrative field. The type of connection event is not as important as the process of bringing individuals together. One director outlined some of these activities as *"promoting collaboration through faculty lunches, research days, strategic planning retreats, communication strategy, regular weekly seminar series, student leadership groups."* The Director also indicated that it was very important for people to attend these connection events especially when it was outside of their discipline. For example, there's a tendency not to attend seminars when the presenter is discussing a topic that is outside of one's area. However, this is the most important feature of the seminar, since gathering ideas and information from other disciplines helps generate innovation.

Research Projects

For many of the Directors that were interviewed, research was a portion of their initiatives' focus. The ability to collaborate on grant applications and work on the intersections of the various disciplines was seen as key to synergy. These research collaborations were seen as mechanisms to increase connections, enhance ideas and broaden the horizons of those members involved. Successful grant applications and research projects also bring more funding and resources which helps grow the initiative. Several Directors also indicated that the most powerful aspect of these research collaborations is allowing individuals to build their own research portfolios and succeed on an individual basis while also leveraging the interdisciplinary collaborations to build something that would not be possible for a single researcher.

Collaborative Space

For synergistic growth, collaborative workspace was seen as an essential element. This collaborative workspace was envisioned as a free-flowing space where members of the interdisciplinary initiative could brainstorm and come up with new ideas and ways to collaborate. Without this inviting collaborative space individuals tend to stay in their office which creates more silos and is an impediment to interdisciplinary work. On the other hand, Directors have seen this open workspace facilitate growth within their interdisciplinary initiative:

"This is shared collaborative space right? And that's how we're going to be successful as a multi is Center Institute. If we just chop this up into like, that's one person's Corner. That's another person's corner and then what's the point right? I don't think that was going to create the synergy that we were looking for right. We wanted people to work together."

For one Director, whose initiative received a large gift to start their Institute, this collaborative space was purposely designed and built into the new building. It has served as a great location to enhance the institute's work. Another director indicated that their collaborative space was created more organically through collective lunches and connection events where members would stay after and brainstorm potential collaborations. This indicates that having a designated

collaborative space can assist with synergy but the process of getting people together and having open discussions is the essential aspect.

Collaborative Equipment

Having shared equipment seems like a natural way to increase synergy within an initiative. The equipment allows members to work on areas of intersectional studies by leveraging collective equipment. Sharing equipment was seen as a way of building synergy but not the main driver behind this factor. Several Directors indicated that as an interdisciplinary initiative they were able to work with members to envision equipment that could prove useful for future collaborative work. This process requires individuals to really think about where they could collaborate within the intersections of the various disciplines. Having the knowledge and understanding of where new equipment could be leveraged to solve problems within the interdisciplinary space is a way of building and displaying the synergy that occurs within these initiatives.

External Organization Involvement

Building synergy within the members of an interdisciplinary initiative is vital but it also is important to extend those connections to external organizations. For many of the directors who we interviewed this their main connection to external agency was through industry. Whether this was collaborations on research or industry participation in events and curriculum, the Directors emphasize the importance of external connections. From a synergy point of view any external connection that can enhance collaboration or bring in new ideas is powerful. One director mentioned the importance of direct line of communication with external stakeholders:

"You wanna have partnerships with those, you know, direct lines of communication with those that you're trying to influence. So it cannot be the indirect line where I publish a paper, and hope that somebody from industry might look up that journal. That's not. That's ineffective."

Strategic Level

Synergy can be thought of as the combination of connections at an operational level as seen in Figure 3 and outlined in the sections above. However, synergy can also be examined from a more strategic level by considering it to be the sum of knowledge connection, knowledge creation and knowledge mobilization. This is illustrated in Figure 3 using the pop-out bubbles on the diagram, which provide a context for these three strategic aspects of synergy. The pop-out bubbles show the change in these strategic variables over time from start-up to ongoing operations. This model for synergy is often more applicable to senior leaders looking to promote and drive interdisciplinary initiatives.

Knowledge Connection

Knowledge Connection is similar to connection events but encompasses additional elements and ways of integrating knowledge from the different disciplines. This could involve external organizations or people from outside the membership of the interdisciplinary initiative. Knowledge connection especially at the boundaries of the integrative field is vital for innovation.

As seen in Figure 3 knowledge creation is vital throughout an initiative. It is key to spark connections at the start and continues to be vital during ongoing operations.

For academic based initiatives knowledge connection could be the creation of integrative curriculum or even a student seminar series with invited experts. For research-based initiatives the knowledge connection is often seen as the sharing of knowledge between individuals from different disciplines and the brainstorming of potential collaborations. This can often take the form of novel ideas that are written up as grant applications.

Knowledge Creation

Colleagues working together on a novel research project is an excellent example of knowledge creation. As the Directors from our interviews indicated, working on the boundaries between different disciplines is an excellent space for new knowledge creation. Looking back at the operational level, this could involve using shared research equipment and may also involve external organizations. From a strategic level, being able to facilitate knowledge creation through synergies within the interdisciplinary initiative is a worthy goal. For academic initiatives knowledge creation can be seen as imparting new knowledge and understanding to students in the program.

From a temporal standpoint it makes sense that time is required to create knowledge. Some of the Directors in our interviews indicated that their initiatives started organically with a collaboration that created knowledge in an integrative field. Other initiatives started with people and knowledge connection which drove towards increased knowledge creation.

Knowledge Mobilization

The culmination of synergy from a strategic viewpoint is knowledge mobilization. Typically, this entails taking the knowledge created in the interdisciplinary initiative and moving it outside the organization. Knowledge mobilization can take many different forms depending on the situation and nature of the initiative. For research initiatives, publication in journals and presentations at conferences are one of the main outlets for knowledge mobilization. However, it is not solely limited to these scholastic endeavors. Part of synergy is working with outside organizations and moving knowledge into industry and other public institutions. For several of the Directors who were interviewed, mobilizing knowledge through outreach events for youth and publicizing the knowledge creation through social media was a vital output. It was noted that some of the most successful interdisciplinary initiatives excel at knowledge mobilization and are known by the general public, which is an aspirational goal for many initiatives.

For interdisciplinary academic programs one of the main knowledge mobilization routes is through graduating students who have completed the program. These students move into public and private industry and bring their interdisciplinary knowledge. One of the Directors indicated that one of their key performance metrics is tracking the number of graduates that move into the workforce and the degree to which their employers are happy with the skills that they bring. These metric measures knowledge creation, but not until the knowledge mobilization phase can it be measured.

As seen in the pop-out bubbles in Figure 3, knowledge mobilization takes time to grow. It is only natural that there is a lag between the start of an interdisciplinary initiative and the point where the organization has reached critical strength for knowledge mobilization to occur.

Output – Impact and Influence

The shape of the curve depicted in Figure 3 is intended to show the exponential growth potential of a successful interdisciplinary initiative. To examine what constitutes success for an initiative there were several different measures that could have been used. Taking input from the Directors, the output along the y-axis can be seen as the amount of impact and influence of an interdisciplinary initiative. Impact and influence were chosen as the measure since it represents the sum of all synergy directed towards outcomes. These outcomes could be in the form of citations for articles in high impact journals. It could also be students who have completed an interdisciplinary program and have had success in industry, moving up into more senior leadership positions. This measure is intended to be broad and encompass the real impact of knowledge connection, knowledge mobilization and knowledge creation.

Shape of plot

Throughout this report the focus has been on successful interdisciplinary initiatives. However, not all initiatives realize their potential for several reasons. The section below utilizes plots to illustrate some of the potential outcomes for interdisciplinary initiatives.

Success

At the start of any new initiative the goal is to be successful and realize significant impact and influence through the output of the collaboration. Those initiatives that do become overwhelming successes have the unique combination of foundational factors which create a basis for success. They also have amassed considerable levels of synergy that have the potential for exponential growth. This exponential growth is only possible with the selection of an integrative field where multiple disciplines work together to drive the initiative towards success. Figure 5 is similar to Figure 3 and shows that a successful initiative is an exponential curve. The order of the exponential curve is determined by the integrative field chosen and the degree to which the various disciplines integrate. Most initiatives are based on bringing together two separate disciplines. However, if there was an integrative field where three or more distinct disciplines could be effectively integrated to work together the resulting plot depicted could be enhanced to a third or higher order exponent. This would result in exponentially higher levels of impact and influence across a broader range of areas.

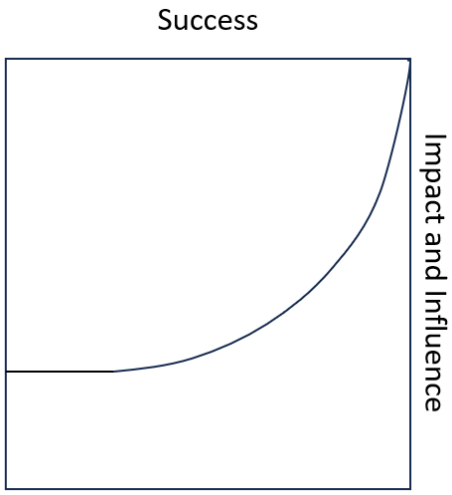

Figure 5: Successful Initiative

One of the Directors mentioned the MIT Media Lab as an example of an overwhelmingly successful interdisciplinary initiative. The field of integration is in Media, Computing and AI which provides space for integrative collaborations. The MIT media lab has created an ecosystem where individuals from both the University as well as external organizations come to share knowledge and generate ideas. The synergies created by their interdisciplinary institute foster collaboration and result in knowledge creation and mobilization. The MIT Media Lab has enabled exponential growth by expanding its field from the original focus on entertainment and learning to include other disciplines including computing and biology.

Partial Success

Despite significant effort from the members, many interdisciplinary initiatives never reach the level of impact and influence desired. These initiatives would be considered partial successes and follow a trajectory like the plot shown Figure 6. There could be a wide variety of reasons why the initiative was not fully successful, but this can often be the result of a few key factors. For partial success the foundation variable is often in place with sufficient resources, governance, and support for leadership. The underperformance comes from either a lack of synergy or the integrative field. Going back to Equation 1 we can see that synergy is the variable that is affected by the exponential term. If there is a lack of synergy this variable stays small, which in turn does not result in exponential growth. With a small amount of synergy, the curve follows a more linear progression. An example of this would be an initiative such as a new center for AI where the membership is comprised of engineers and social scientists. This is an example of an integrative field that has proven to be successful in other institutions. However, in this case there is very little synergy between the members and results in only partial success.

Partial success is also observed when the exponential term or integrative field is not effective. This is the case when there is little integration in an initiative. An example of this is when two

disciplines are brought together to work in an interdisciplinary institute but only one of the disciplines contributes. In this case we effectively have the power of the exponent in the formula equal to 1, which creates a linear output. The other way this can occur is related to the selection of the field. If a field is selected which does not facilitate integration or if the field is in a non-growth area this can also occur. One of the Directors described an interdisciplinary initiative in fuel cells which had all the required aspects for success including the foundational components and lots of synergies, but the field did not allow for exponential outcomes.

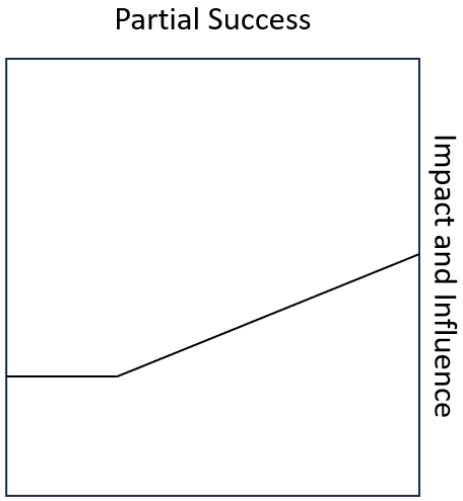

Figure 6: Partially Successful Initiative

Minimal Success

The plot of a minimally successful initiative shown in Figure 7 represents a waste of time and resources. In this example the foundational factors were in place, but the integration of the fields was a failure. Mathematically this creates a situation in the formula where the exponent goes to zero, which makes the synergy term equal to 1. Therefore, there is no contribution from the synergy term and all that is left is the foundational factors. These types of initiatives can result is some very minimal levels of impact and influence but given the amount of resources and effort allocated it is not he desired state for any initiative.

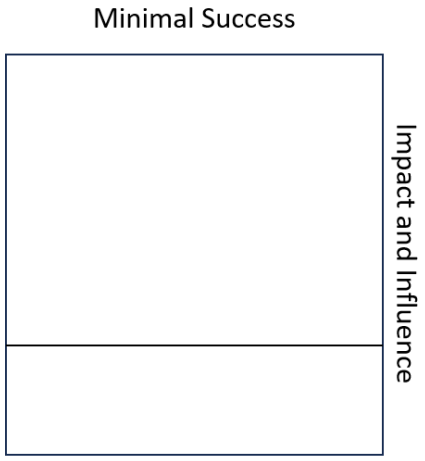

Figure 7: Minimally Successful Initiative

Failure

Failure is something that no interdisciplinary initiative wants to experience. As seen in Figure 8 there are different sections in this plot, but the most important aspect is not the shape of the plot in the middle but rather that it goes to zero at the end. The way that an initiative goes to zero can either be from the Synergy variable being zero or from one of the factors within the Foundation variable being zero. It is rarely seen that the Synergy variable goes to zero as there are so many ways to connect and collaborate within an interdisciplinary initiative. There can be low synergy, but having zero synergy is rare. Failed initiatives usually stem from the withdrawal of resources, lack of governance or lack of leadership support. If any one of these factors goes to zero, then the initiative fails. During the interviews one of the Directors indicated that it is a lack or withdrawal of support from leadership that ultimately dooms an interdisciplinary initiative. In this case you can have a great integrative field and outstanding synergy, but it all tends to zero without support from leadership.

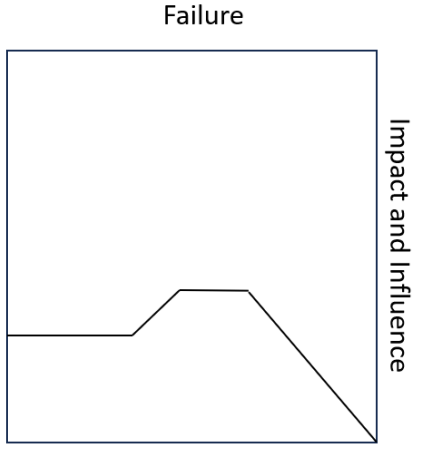

Figure 8: Failure of an Initiative

Conclusion

This report provides a formula for success for interdisciplinary initiatives and examines the key variables which contribute to success. The framework can help in the development of new interdisciplinary initiatives including determining where investments and resources should be targeted. The formula can also be applied to existing interdisciplinary initiatives to provide insight on how to optimize impact and influence. Future work will involve additional validation of the model.

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