Organizational Perspective on Leadership Strategies for the Success of Cross-Disciplinary Science Teams

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Abstract

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Institutional contexts have a dramatic impact on cross-disciplinary team science by creating the conditions that can help or hinder these efforts. Though team science leaders have limited control over many of these conditions, through proactive management and use of robust strategic planning techniques, leaders of cross-disciplinary science teams can improve their chances of success. At the strategic level, leaders must understand why cross-disciplinary science teams and organizations are created and analyze the other important actors in the environment to develop their situational awareness. At the operational level, leaders must understand how to manage relationships with participants and with other important actors and what the team provides that is of value to those that it depends upon, thus creating a viable value proposition and a successful value chain. Armed with an understanding of their external situation and their internal operations, science team leaders can make better strategic decisions to improve the munificence of their institutional situations and enhance their likelihood of success.

Keywords

Team science
Value proposition
Value chain
Organizational
Strategy
Cross-disciplinary

25.1. Introduction

Traditional views hold that research is performed by individual scientists; recent work has raised awareness of the importance of science performed in teams of up to nine members (National Research Council 2015). Both solitary researchers and science teams can be found in universities, corporate settings, and federal agencies and labs. Increasingly team members are drawn from across organizational boundaries and may be organized as larger formal and enduring organizations such as centers, institutes, or consortia with designated directors, specified membership and roles, and written policies and procedures (Bolukbasi et al. 2013; Winter et al. 2014). This trend reflects the growing focus on addressing complex intellectual challenges and solving significant societal problems—pursuits that are difficult for individual scientists or short-lived informal science teams to engage.

Teams, centers, institutes, or consortia are science organizations that are subject to many (though not all) of the same dynamics as other organizations, suggesting that insights drawn from extensive research in organizational studies can be beneficial to the field of Team Science. Many date the formal study of organizations to the work of Frederick Taylor on scientific management (Taylor 1910), which inspired generations of researchers to identify principles and techniques to optimize internal efficiency and effectiveness through components such as leadership, job design, incentives, and communication. Later theorists were inspired by developments in the open systems movement that focused on organisms embedded in and open to the influences of their environments. Organizational theorists adapted this view to emphasize the interdependence of organizational units and their environment (Thompson 1967) and developed methods and techniques to assist in the analysis and management of these complex relationships (Pfeffer and Salancik 1978). This chapter follows in the tradition of these open system organizational theorists to highlight the importance of the context within which research is carried out, be it by individuals, science teams, centers, institutes, or consortia.

The open systems view considers the relationship between an organization and its context or environment to be of paramount importance because the environment provides the resources that are needed for organizational survival including both tangible resources such as funding, space, personnel, and equipment and intangible resources such as good will and legitimacy (Pfeffer and Salancik 1978). In return, organizations provide valuable outputs. In science organizations, these are often publications, patents, and trained graduates. Although the traditional view of research has focused on the individual researcher, the role of their environment is widely acknowledged: scientists are successful partly because of the support provided by the organizations that they are embedded in. In the United States, the typical university was created to advance knowledge and provide instruction in a variety of academic disciplines. It is divided into colleges, and subdivided into departments reflecting academic disciplines, because this structure allows individual researchers to be successful. Universities have developed complex policies, practices, structures, and cultures that reflect and support their research mission (Cutcher-Gershenfeld et al. 2016; Winter 2012), but this institutional context can be a hindrance to large-scale, coordinated, and cross-disciplinary research.

Cross-disciplinary research is becoming increasingly important as science is asked to address complex intellectual challenges and significant societal problems that seldom fall neatly into a single academic discipline or department and may require sustained efforts with little immediate economic payoff. Corporations find it difficult to address these challenges and societal problems due to the market forces that keep them focused on short-term profits, not basic research or breakthroughs that cannot be easily monetized. Federal agencies and labs were designed with particular missions in mind so have difficulty quickly addressing emerging issues that may not fit squarely within ~~in~~ their mission. Engaging complex intellectual challenges and solving significant societal problems requires building a body of cross-disciplinary scholarship, developing innovative products, processes, or services, delivering these innovations, and changing user behavior (Winter and Butler 2011). Cross-disciplinary teams and institutions such as centers, institutes, and consortia are often created to coordinate efforts and share resources across disciplinary, organizational, state, national, and sector boundaries, but they can be facilitated or hindered by the system of rules, policies, regulations, and practices of their environments—their "institutional context." Some of these cross-disciplinary science teams and organizations survive for decades and are very successful (e.g., CERN), but many last only a few short years and never meet their full potential (Bolukbasi et al. 2014).

In many ways, this is not surprising. Cross-disciplinary teams and organizations share many characteristics with other new ventures that have been studied extensively. Research has found that 50% of new businesses fail within 5 years (Bureau of Labor Statistics 2017)—a phenomenon that has been termed the liability of newness and smallness. We see similarly daunting odds for new ventures that are not specifically focused on profits and are more reliant on volunteer efforts such as online communities like Wikipedia, and citizen science collaborations like NanoHub (Freeman et al. 1983; Gaglio et al. 1998; Olson et al. 2008). Like science teams, new ventures have little control over their institutional contexts, which can be supportive or extremely challenging. We know a lot about what new ventures can do to succeed; this knowledge can be applied to cross-disciplinary science teams and organizations. This chapter presents three robust strategic planning frameworks from the organizational science domain that research leaders can use proactively to improve the success of their boundary-spanning and cross-disciplinary science teams.

25.2. Cross-Disciplinary Science Teams as New and Small Organizations

New organizations face significant challenges including attracting resources, initiating operations, and becoming sustainable. Many universities have created incubators to provide help in meeting these challenges for new businesses, but do not provide equivalent support for interdisciplinary scientific teams and organizations. New business incubators provide a variety of tangible and intangible resources such as seed funding, space, and the legitimacy of being associated with an incubator. Legitimacy—the perception that an organization is pursuing acceptable goals through appropriate means (Suchman 1995)—plays a central role in attracting resources (Starr and MacMillan 1990). More importantly, new venture incubators provide access to managerial and entrepreneurial expertise that helps teach new venture founders how to succeed. This expertise spans topics such as strategic planning, accounting, budgets and finance, operations management, human resource management, and marketing.

Similar to new venture incubators, many cross-disciplinary science teams and organizations at universities are also provided space, seed funding, and legitimacy, all of which can help them in attracting additional resources (Starr and MacMillan 1990). Associating with a respected university may enable cross-disciplinary science teams to gain legitimacy by emphasizing consistency with university goals (advancing knowledge or providing instruction) and means (scientific research, classroom, or online instruction). However, unlike typical new venture incubators, science team leaders are seldom provided access to expertise or training in how to create and manage a successful organization.

Like other organizations, cross-disciplinary science teams also need to attract or gain control over resources in their environments such as space, facilities, equipment, raw materials, and data or financial capital that can be used to purchase these resources (Zimmerman and Zeitz 2002). Space and financial resources for scientific teams, centers, institutes, and consortia are often highly constrained in university settings. Most new businesses are funded through personal debt (founders' credit cards and loans from family and friends), avenues not often available to leaders of cross-disciplinary science teams. Successful leaders may be able to secure additional sources of capital (e.g., research grants, contracts, donations of cash or in kind), but the timing of these resource infusions is critical. Delays in funding can result in the loss of valued personnel when funding runs out followed by a hiring scramble when new funding is secured.

Attracting human capital can also be more complex for science organizations than it is for most new ventures due to the unique mix of paid staff, soft money positions, and volunteers. The success of many university-based cross-disciplinary science teams relies upon volatile soft money positions together with voluntary participation of faculty members and graduate students. Voluntary participation can be particularly difficult to achieve and maintain with over-committed faculty and students whose primary obligations and incentives are only loosely related to their engagement with the science organization. Many universities do not provide incentives to work across boundaries, and cross-disciplinary work, science organization administration, and collaborative science may not be recognized in hiring, promotion, and tenure policies.

In addition to attracting resources, new organizations face challenges in initiating their operations. Processes must be created, job descriptions written, personnel hired, facilities leased, equipment purchased, and products or services created and delivered. Although it sounds obvious, successful organizations need to proactively identify and then manage the products or services that they provide. For many new ventures, the nature of their products and services are relatively straightforward: restaurants serve food. For other new ventures, there is considerable ambiguity: whether Uber provides transportation services or just information exchange is still being contested. For science teams, the products and services are often less obvious but can include disseminating knowledge through white papers, social media posts, publication, patents, and educational programs, importing knowledge through guest speakers, journal clubs, and organized symposia or seminars, or maintaining collaborative writing groups, supplying mentoring, or providing data analytic services or data products, etc. Successful science organizations proactively manage the set of products and services that they provide.

Once the suite of products and services has been identified, processes and structures must be put in place to create and deliver them. Many of the processes that must be created are constrained by, often very complex and conflicting, laws or policies. For example, an urgent hire may be delayed for months because of centralized approval of all job descriptions, minimum job posting times, rules against jobs being split across organizational units, or the negotiation of complex financial agreements between colleges. Similarly, a promising line of research may be impossible to pursue because the institution does not have the ability to handle HIPPA-compliant data. The team may not be able to purchase necessary equipment because procurement has not qualified the vendor, it is not an allowable expense, or a member of the team has a financial conflict of interest with the vendor. Cross-disciplinary science teams need to determine which rules apply and how best to get things done. Science teams that cross organizational boundaries (multi-departmental, multi-college, multi-university, multi-national) will often have to reconcile incompatible rules and processes, which may require complex memos of understanding (MOUs) and legally binding agreements about issues such as division of intellectual property rights, data sharing, export restrictions, joint human subjects reviews, restricted research, and conflicts of interest or commitment (Lutters and Winter 2011).

In addition to these more tactical challenges faced by science teams and organizations, their long-term success and sustainability can be enhanced through robust strategic planning, a topic of long-standing interest in business and entrepreneurship. A number of strategic planning frameworks have been developed to understand why some organizations succeed while others fail and to guide leaders in their strategic planning efforts and enhance the likelihood of their success.

25.3. Strategic Planning Frameworks for Science Leaders~~:~~

Three frameworks are widely used to help organizations become sustainable: (1) assessing and influencing the environment they are operating in; (2) managing their stakeholders and developing their communication strategy; and (3) fulfilling their value propositions. All three of these frameworks can help leaders of cross-disciplinary science teams achieve sustained success.

25.3.1. Strategy 1: Assessing the Environment for Cross-Disciplinary Science Teams

Organizational science has long recognized that success and longevity is easier in some environments than in others and that effective leaders take actions to improve their environment (Porter 2008; Thompson 1967). Building on Porter's work, we can develop a framework for assessing a science team or organization's environment and identifying components that leaders can influence to make it more likely that the team or organization will survive and thrive. In this framework, it is important to consider all of the relevant stakeholders—the individuals, groups, organizations, or institutions that care about your team's activities and whether or not you succeed. Porter identified the importance of existing competitors, potential customers, potential suppliers, possible substitutes for your product or service, and potential new entrants (Porter 2008). Science leaders should identify analogous stakeholders in their environment and also consider funders and regulators.

Competitors: Initially, it might seem easy to identify existing competitors and determine how fierce the competition is among them, but this is often a very difficult task because it requires an organization to determine what its product or service really is (a topic that we will return to when we talk about building a value proposition). At a minimum, leaders of cross-disciplinary science teams should be aware of other similar teams and how their efforts compare. Are they complementary, competing, or irrelevant? If they are complementary, can you form a partnership that strengthens both of your efforts? If they are competing, how will you differentiate your efforts (more focused on basic research, tailored for a particular use like education or economic development, more policy-oriented, more focused on transition to practice or commercializable products, etc.)? If they are irrelevant, how will you monitor their efforts and influence them to make sure that they do not become competitors? If there are lots of existing competitors in a space and the competition among them is intense, it is less likely that a new science team in this area will be successful.

Customers: Porter (2008) considered the environment to be positive, and, consequently, a new science team is more likely to succeed if there are lots of potential customers who want the things that the team can provide and these customers act independently so they cannot organize to make demands that would be difficult to meet. This means that successful cross-disciplinary science teams must determine who would want the things that they can provide (their potential customers) and whether there are multiple kinds of customers.

Tangible products or services of interest to potential customers could include a center's research publications, colloquium or speaker series, white papers, patents or other intellectual property, contract research services, or educational offerings such as seminars, workshops, and certificates. Intangible benefits of interest to participating members of the research team or center could include mentoring, a sense of community, visibility, intellectual engagement, insights, and motivation. Customers can be funding agencies, graduate students, other researchers, policy-makers, companies hoping to buy or license intellectual property for commercial development, or students hoping to learn specialized skills and their potential employers.

Customers themselves are often not sure what their needs are so a team must first figure out their potential customers' needs (which may be an iterative process) and how to meet them. Many entrepreneurship programs are embracing a "lean start-up" form of new venture creation that rapidly moves between identifying unmet needs, developing products or services that meet those needs, and then seeking feedback on how well the products or services have met those needs (Wilson 2011). Although this iterative process of prototyping and testing various products and services with potential customers may get a new science team started, sustained success often depends upon the team building on what it offers that is unique and difficult to duplicate (Barney et al. 2001). For example, many competitors can produce white papers or publications, but a successful science team will have valued insights that others do not have and cannot easily develop. If these insights are fairly straightforward and are drawn from publicly available data, other teams may be able to provide them faster or more easily. If these insights are unique to the members of the team or to the resources available at a particular university, or stem from a trusted relationship with a funding source or exclusive support from an industry partner, it will be difficult for other teams to duplicate them. Successful sustainable science teams may need to attract and retain key people, affiliate with a particularly prestigious university, build strong ties to funding sources, or develop exclusive industry partnerships.

Resource Suppliers: Just like for customers, Porter (2008) considered the environment to be positive and a new science team is more likely to succeed if there are lots of potential suppliers for each of the needed resources and they act independently so they cannot organize to raise prices or make demands that would be difficult to meet. Potential suppliers for cross-disciplinary science teams can include a variety of providers for resources. For most teams, skilled personnel will be the most important resource. However, some teams may rely on access to scarce or expensive equipment such as the Large Hadron Collider or on computational resources such as valuable datasets and high performance computing services. Even suppliers of more mundane services such as payroll processing are important, but, since many of these services are supplied within the employing institution such as the university, they are not of direct concern to science team leaders. If there is a single source for a critical resource, leaders of cross-disciplinary science institutions should consider taking steps to ensure a continuous supply of that resource by, for example, entering into long-term contracts or including the provider as part of the institution through an MOU, consortium agreement, or some other form of contract.

Substitutes: Porter (2008) also suggests that cross-disciplinary science teams should consider possible substitutes for their products or services. Just as Uber is a viable substitute for car ownership in many large U.S. cities, a science team's potential customers could get their needs met through other means. Readers can easily learn about a topic from Wikipedia instead of from your white papers or publications, so it is important to think about what you can provide that does not duplicate what is in Wikipedia. Maybe a YouTube presentation can present material in a better format or make more complex material more easily understood. Of course, this may not be consistent with the tenure requirements in place at the university and may require advanced marketing skills that would have to be acquired, so science team leaders need to balance these conflicting needs and develop policies that enable the success of both the team and its individual members. Science teams should think about questions like why companies would license intellectual property from you when they can develop their own. Can students gain valuable skills through online videos or a massively open online course (MOOC) instead of relying on your courses, seminars, workshops, or similar offerings?

New cross-disciplinary science teams should also be aware of whether they are a substitute for an existing organization's products or services. New substitutes often disrupt markets and may drive existing organizations out of business or firms that produce the substitute may be acquired to remove the threat. For example, Wikipedia has disrupted the market for printed encyclopedias; flexible, extensible cloud-based data storage and open source statistical software such as R are disrupting university data centers and the market for traditional statistical software such as IBM's SPSS. A science team that creates a new method for handling clinical samples may be a threat to existing services. If a team does pose a threat to a powerful existing group, it should develop strategies to manage this concern.

New Entrants: New cross-disciplinary science teams may not provide a substitute for an existing product or service, but simply be a new entrant into an existing research environment. Porter (2008) suggests that they should consider the likelihood that other new entrants may be emerging who can become competitors for both customers and resources. Although potential new entrants are always a concern, they may be particularly likely when a cross-disciplinary science team focuses on a trendy topic such as big data, personalized medicine, or cybersecurity. New entrants can benefit from the knowledge gained by existing teams and capitalize on that knowledge to avoid the mistakes that were made by first movers, called the second mover advantage (Birger 2006*;* Epstein 2006*)*. In many fields there are considerable barriers to entry such as expensive facilities or scarce resources such as proprietary data. Teams that can overcome the high barriers that dissuade potential new entrants are more likely to be successful.

Funders: Cross-disciplinary science teams must also consider funding streams. These may be sources of start-up capital such as internal seed grants, competitive research grants, and donations. Some of the sources of start-up capital that are available in the economy but are often not available to new science teams within universities are crowdfunding (the equivalent of angel investors in the entrepreneurship world), banks, and venture capital. These sources can be tapped if the science team pursues commercialization of their innovations, but they require the creation of a legal entity that is separate from the university and considerable entrepreneurial and managerial activity that is not directly linked to supporting the research team itself.

Successful science teams must also develop sustainable funding streams that provide a recurring infusion of funds. Many cross-disciplinary teams rely on a single funding stream leaving them vulnerable to disruptions. A team that has been very successful in receiving funding from a single federal agency program may find its future jeopardized if that program is discontinued. Diversifying across funding sources helps buffer the effects of changes in any single source. Teams could pursue additional revenue-generating arrangements such as technology licensing agreements, industry partnerships, successful grant proposals to a broader array of funders, or user fees.

Although science team leaders seldom think about the legal form of their team, each team is bound by a set of legal constraints. Team leaders should be aware of the different legal forms that are available since they have implications for how their funds can be held, distributed, and taxed. For example, many teams are legally located within a university, which allows the university to handle the funds, create accounts, and designate signing authority. The university handles tax issues, payroll, benefits, and so on, and recoups some of these expenses through overhead. Many funders such as the National Science Foundation (NSF) do not make awards to individual researchers but to their employing organization so a scientist at a university may have no actual legal claim to the funds. The university has designated the scientist as the investigator responsible for carrying out the work, but is well within its legal rights to designate a different investigator (with NSF's approval). Some funders hold the entire PI and co-PI team responsible for late or missing reports. If a science team member changes employment, he or she will have changed their legal status and may become ineligible to receive funds from the grant, access the data that have already been collected, or use research equipment purchased through the grant.

In addition, the relative permeability of work units such as departments and centers may vary, so crossing a university's boundaries may be more difficult in some situations than others. Large, international collaborations may require complex interorganizational contracts, nondisclosure agreements, MOUs, and export control measures. Instead of relying on the university as the home institution, long-lived cross-disciplinary science teams may also use the 501(c)3 organizational form that is available for not-for-profit scientific and educational organizations and formally designate ~~its~~ their own officers with authority to receive and disburse funds and to store, curate, and archive research data.

Regulators are more of a concern for some cross-disciplinary science teams than others, but none is entirely unregulated. Those housed within universities take advantage of existing systems to comply with, for example, IRS regulations through proper accounting practices, Institutional Review Board (IRB) policies for proper treatment of human subjects, and Occupational Safety and Health Administration (OSHA) requirements for workplace and lab safety. Funding agencies, accreditors, and licensing organizations may also act as regulators. Cross-disciplinary science teams that are aware of regulators' concerns and work proactively to address them are more likely to be successful.

In sum, there are many ways in which a cross-disciplinary science team's institutional environment can help or hinder its development and survival. Some of these are difficult for a team to influence, but other aspects of the team's situation can be engaged to improve the probability of success. Organization science provides a robust strategic planning framework that can be used by team leaders to better understand and manage their team's situation (Porter 2008).

As this section has shown, Porter's framework considers the organization an open system and can be used to assess the environment for cross-disciplinary science teams. Science leaders can consider the relevant stakeholders in the environment: existing competitors such as similar science teams, potential customers including individuals or organizations that would want the insights, products (e.g., papers, patents, presentations), services (e.g., analysis, recommendations, training) that the science team provides, potential suppliers of needed resources such as skilled personnel or valuable datasets, possible substitutes for a team's products or services, potential new entrants, diverse funding streams (investors), and regulators. Each of these will affect the team's situation within its institutional context and can affect its success. Analyzing the team's environment is the first step toward enabling science leaders to take positive action to improve their likelihood of success and longevity.

25.3.2. Strategy 2: Stakeholder Management

Stakeholder management is a second organizational science framework that provides additional detailed guidance to science team leaders ~~t~~so that they can improve their environment (Donaldson and Preston 1995; Freeman 1984). As with Porter's Environmental Forces framework (2008), stakeholder management grew out of the realization that organizations are open systems so are dependent upon their environment, and that one of the most important functions of a leader is to manage the various stakeholder entities (individuals, organizations, and interest groups) in their environment that control the organization through the exchange of resources (Pfeffer and Salancik 1978). As open systems that are dependent on their environment and are influenced by various stakeholder groups, science team leaders need to identify and manage their stakeholders.

Springman (2011) summarizes best practices in stakeholder management and lays out a set of steps to be taken. First, identify stakeholder groups, and for each identified stakeholder group, develop a value proposition and determine what you want from them in return. Then identify any capabilities that will need to be developed to provide what stakeholder groups want and prioritize them based on the importance of the stakeholder groups whose demands they address. Finally, organizations should track how well they are providing value for their stakeholders.

These steps apply equally well to science teams. Stakeholders should be identified and their levels of power and interest should be determined. The science team should develop value propositions for each of their stakeholders and what they want from these stakeholders in return. Finally, science teams should create a strategy for stakeholder communications and relationship management. Science teams need to decide how much attention to pay to each of their stakeholder groups and create communication plans that assign communication responsibilities to team members and specifies communication frequency, media, and goals. This plan should include metrics that track how well the team is providing value for its stakeholders.

25.3.3. Identifying Stakeholders

Porter's 2008 framework provides categories science team leaders should consider when identifying any relevant stakeholders (including competitors, customers, suppliers, substitutes, potential new entrants, funders, and regulators. Of course, the detailed list of specific stakeholders will be closely tied to the nature of the science team and its activities. Stakeholders that play multiple roles should be considered stakeholders in multiple categories. For example, a faculty member may both disseminate information by writing papers and consume information by reading papers written by other team members. Science teams doing similar or complementary work are significant stakeholders and can be competitors, customers, or partners depending on the details. Customers can also include companies that collaborate with the science team on research projects and those same companies may be potential employers of students who have been trained by the science team.

Other customers may be faculty and student participants, journal publishers, and university administration that benefit from publication and intellectual property (IP) streams. State and federal governments can be important stakeholders when research teams are located in state universities and for intramural researchers in federal or state agencies.

Resource suppliers can include faculty and student participants who provide the knowledge, skills, abilities, and time that make a team successful. Data resources, equipment, and technical support may be provided by IT services or by partners at other institutions. Department chairs, deans, and provosts may provide valuable space and access to crucial administrative expertise for tasks such as preparing grant proposals, processing expenses, handling payroll, and personnel issues.

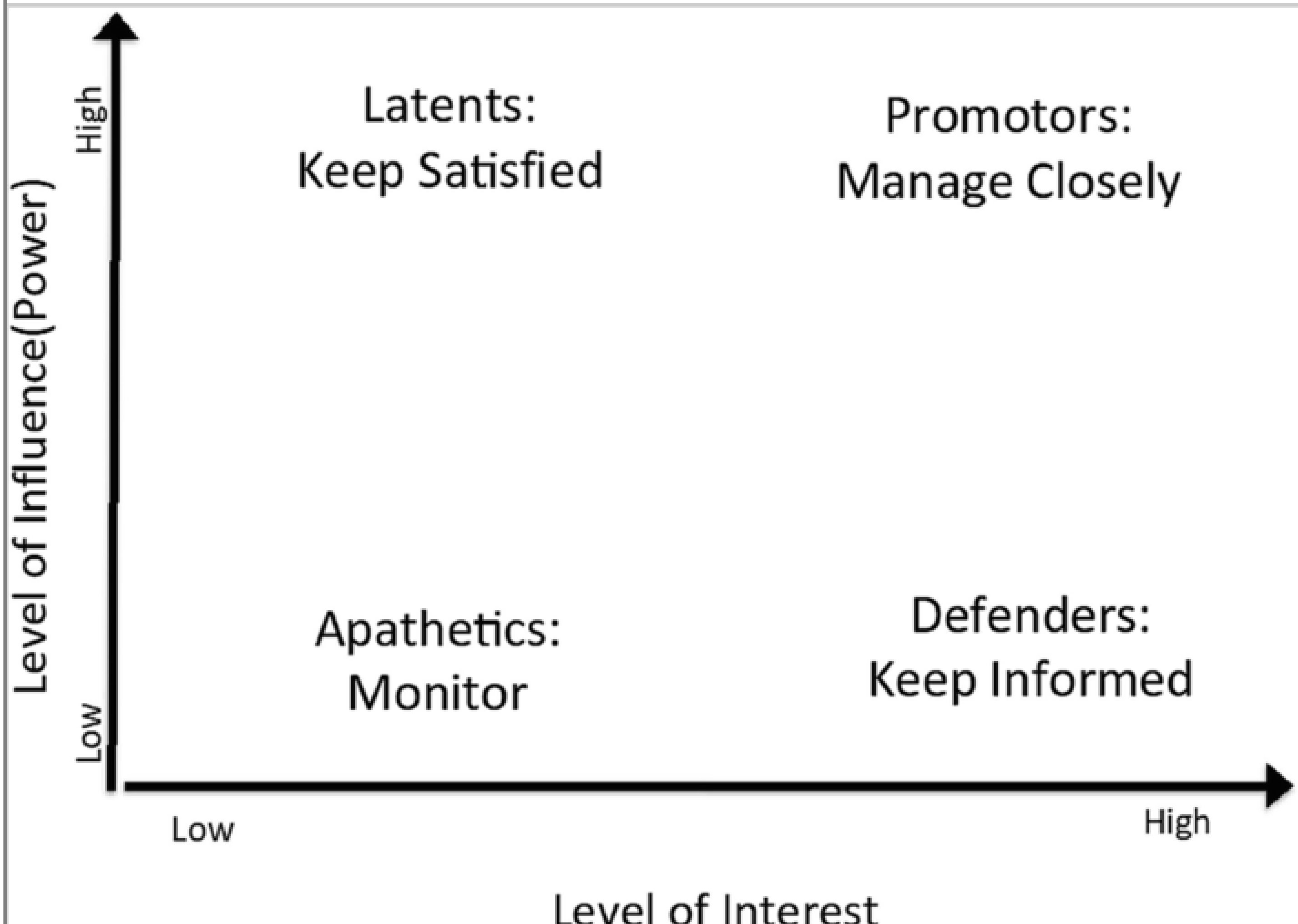
Science team leaders should also identify new teams that may emerge and could compete for customers and resources. The likelihood of such new entrants will vary. It is easier to assemble a small team of researchers to complete a single project than it is to create a large sustainable center, institute, or consortium. Teams working on currently popular topics will more likely see many more new entrants than those working on areas that are not receiving as much attention. Some activities will require expensive and scarce resources making new entrants less likely, but this can change if costs fall and access increases. Team leaders should consider these factors in identifying potential new entrants. Funders and regulators will also vary depending on the particulars of the research collaboration.

25.4. Stakeholder Analysis

Mendelow (1991) developed the stakeholder power grid to help leaders visualize the importance of various stakeholder groups. Stakeholders differ in how much they are interested in the science collaboration and in how much power or influence they have with the team (Mitchell et al. 1997). Figure 25.1 provides an overview of the stakeholder power grid. Once research team leaders have identified the relevant stakeholders, each should be assigned to a quadrant of the stakeholder power grid. It is worth revisiting this categorization periodically since a stakeholder group's interests may change.

Fig. 25.1

Stakeholder power grid



Stakeholders with low levels of power can be divided into "apathetics" and "defenders" or fans. *Apathetic stakeholders* with low levels of interest and power such as students unaffiliated with the science team or its topic require (and often prefer) minimal effort. The majority of students at a university (those not interested in the topic or involved in the science team's work) will likely fall into this category. They do not need to be actively managed, but should be monitored to make sure that they do not move into one or another category (e.g., developing concerns about the team's ethics or excitement about a new breakthrough).

Defenders or Fans have a high level of interest, but very little power or influence over the science team. They are likely to act as champions and tout the value of the science team and its work. Alumni who worked with the team before graduation may be defenders.

Stakeholders with moderate power and influence will vary in their level of interest. If they are interested, they could make things more or less difficult for the science team. For example, department faculty who are not part of the science team could devalue collaborative research at tenure time, argue to the Department Chair that their space needs outweigh yours, and refuse to serve on your students' dissertation committees or serve and require unnecessary changes that delay your students' time to completion. Because they can affect the collaboration's success and even its survival, stakeholders with moderate levels of power and interest should be actively monitored and steps should be taken to maintain their support.

Stakeholders with high levels of power can be divided into "latents" and "promoters" or key players. *Latents* are stakeholders who have considerable power and influence over the science collaboration, but relatively little interest. For example, university space allocation and facilities administrators are unlikely to be particularly interested in the science team's success (insights, papers, patents), but may have the power to take away lab and work space. Similarly, often at state universities the state owns the equipment being used by a science team and the land where the lab space is located. Regents and State Legislators can wield enormous power. This means that state officials could make these essential resources unavailable. They usually have relatively little interest in the team and are unlikely to exercise this power. However, these latents should be kept satisfied and it is worth monitoring these stakeholders' levels of interest so that additional steps can be taken if necessary.

Promoters are key players with considerable power and influence over the science team and high interest in it. A major funder may have a high level of interest and a high level of influence, so is a key player who should be managed closely.

Promoters and Defenders should be actively and frequently engaged. Finding roles for them among the team's leadership, for example, in an advisory capacity, is an excellent way to ensure that they are properly included.

25.4.1. Developing a Communication Strategy

Successful stakeholder management requires a communication strategy (Mendelow 1991). However, many science teams do not systematically consider stakeholder management or develop a communication strategy. They are more likely to decide that they need to have a website than to systematically consider the audience for that website and the messages that they want to convey (Lutters and Winter 2011). This focus on the communication medium rather than the audience or the message can represent a missed opportunity to influence the institutional environment and may jeopardize the success of the team.

Science teams should determine what information each stakeholder or audience would be interested in hearing. Audiences can be external or internal and can include the public, politicians, university administration, customers, staff, funders, and regulators. For example, a team's customers would want to hear about the products or services that are available and the value that they provide (the value proposition). A major donor is more likely to want to hear success stories highlighting the team's impact and to be informed about financial accounts and how their donation is being used. Board members may want to hear about all of these and about internal policies and practices.

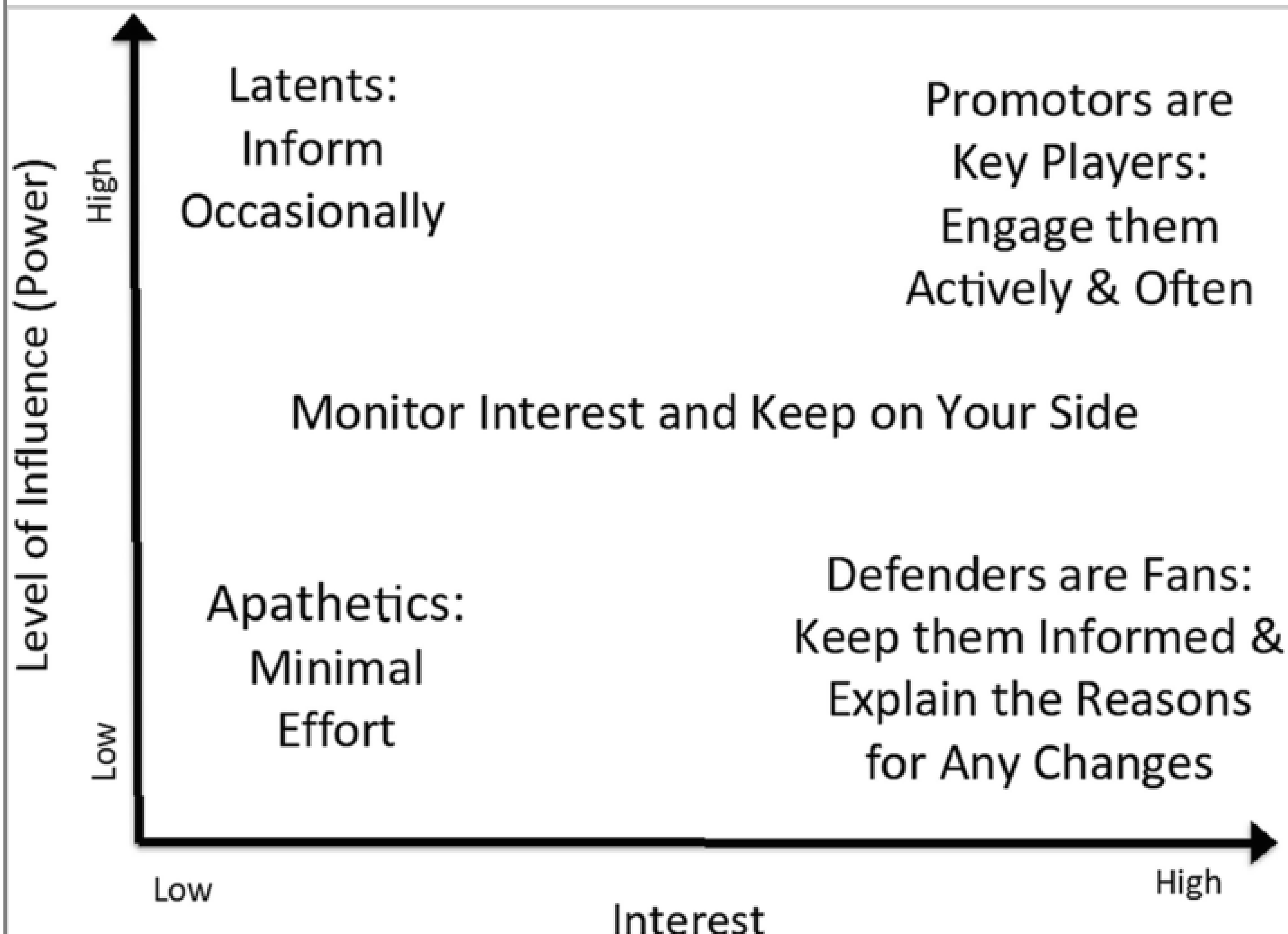
Understanding what a stakeholder group wants to hear will require understanding what motivates them. Building this understanding can be done in many different ways, some of which depend on the specifics of the science team's situation. Informal conversations with faculty and students can provide a wealth of information. Conferences and workshops provide valuable opportunities to collect information from a broader sample. More formalized data collection methods such as focus groups and surveys can be used for current students and alumni. A careful exploration of websites can help clarify the goals of funders, regulators, and other science teams. University development officers can clarify the goals of alumni, and research development offices can often provide insight into the concerns of major foundations. Most universities also have offices of legislative affairs that can provide information about the interests and concerns of local, state, and federal governments and may have outreach plans that science leaders can participate in. Some communications offices will provide training in effective communication of research activities and results. Advisory boards can also provide valued insight.

Once the stakeholders have been identified and analyzed, the team can set communication goals for each stakeholder group. Do you want to raise a potential new team member's awareness of what the team has to offer or are you hoping to motivate the University Provost to provide the team with lab space in a central location? An effective message can then be developed that shows how meeting the team's needs will also meet the stakeholder's needs. For example, communicating to a potential new member that if they join the team they will have access to research data that will lead to high quality publications and tenure. Similarly, communicating to the Provost that the new lab in a central location will be a more efficient use of a currently underutilized space.

Finally, research teams should prioritize stakeholders and set appropriate goals for communication frequency. Figure 25.2 shows communication guidelines for stakeholder types.

Fig. 25.2

Overview of stakeholder communication strategies



Apathetic stakeholders require (and often prefer) minimal effort. Receiving an annual newsletter or website update may be sufficient to manage this relationship.

Defenders and Promoters should be the focus of most of the science team's communications efforts. *They* should be communicated with frequently so that they feel informed and it is important to make sure they are provided reasons for any significant changes. Posting breaking news on the team's website or via twitter can help this group stay informed. Likes, comments, and re-tweets can help the team gauge the overall mood of the defenders (the "fans"). This kind of brief, instant communication can be supplemented with more in-depth information provided through an outlet such as a monthly newsletter or annual report. Placing promoters in key leadership or advisory roles enables even more in-depth communication.

Stakeholders with moderate power and high levels of interest should receive communications more frequently than those who have a ~~high~~low level of interest. This could include inviting them to events such as public talks given or hosted by science team members, or "friends of" receptions or lunches at major conferences. They may also appreciate receiving science collaboration products such as annual reports or papers.

Latents can often be satisfied with targeted, but relatively infrequent~~ee~~ communications. For example, providing information to the university that it can incorporate into its annual report to the Regents and to the State may be sufficient.

25.5. Developing a Communications Plan

The last, and perhaps most important step in developing an effective communication strategy is to create a concrete plan for developing appropriate messages, delivering them via preferred media and in a timely fashion. The team should determine who is responsible for key communications activities and develop a budget, resources, and timeline for implementation. Finally, the team should identify how it will measure success and determine if its communication goals are being met. Are the number of hits on the website sufficient or is the team's goal to get their key messages mentioned in media coverage? Appropriate milestones to measure progress toward these goals should also be developed.

Understanding your team's environment and communicating the team's "value proposition" to stakeholders is extremely important to the success of science teams. Organization science has also found that leaders need to pay attention to their internal operations so that their team can actually make good on their promises and deliver what their stakeholders value. Being able to communicate this value proposition and provide good value will enhance a team's ability to navigate even a difficult institutional environment and achieve success.

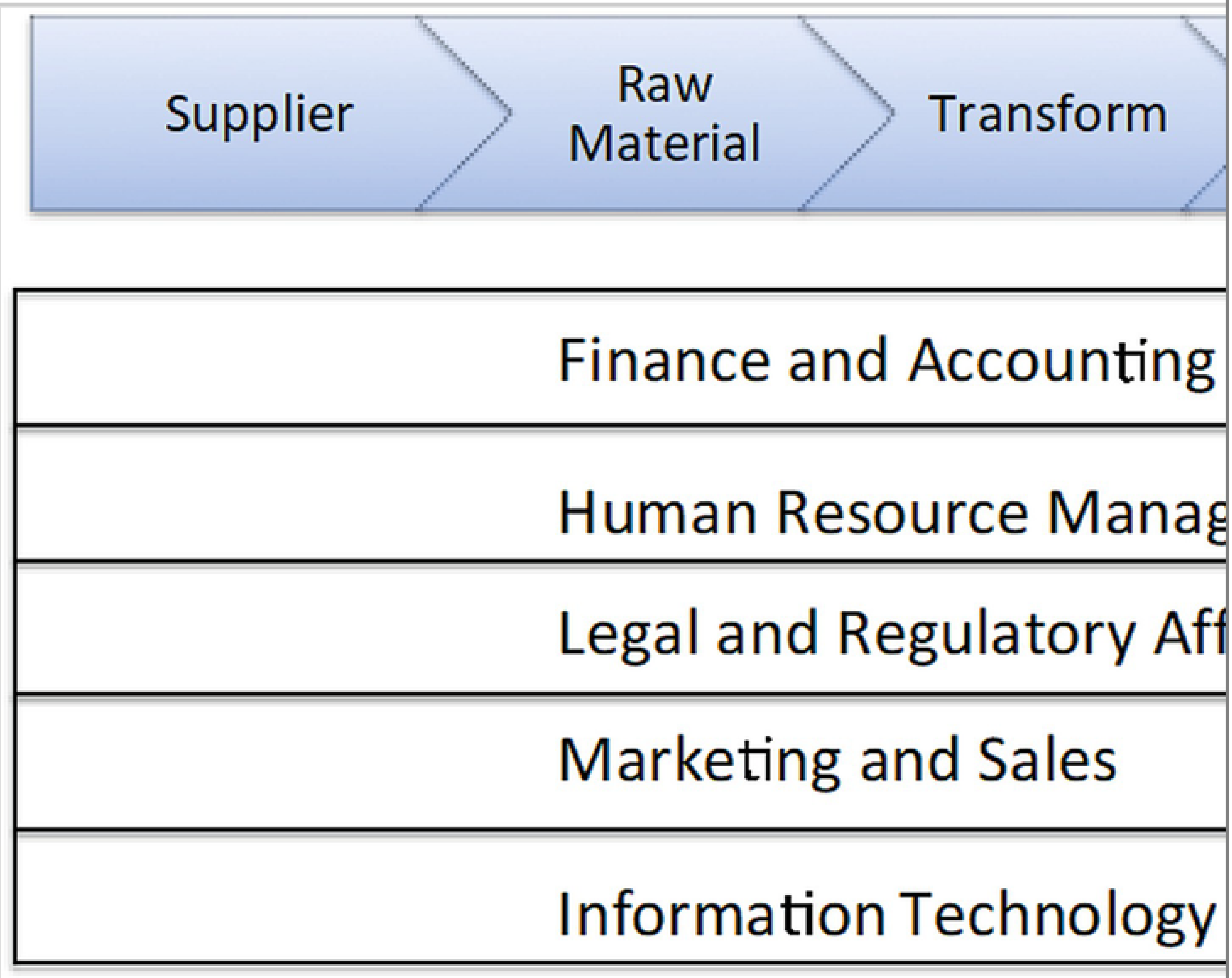
25.5.1. Strategy 3: Fulfilling the Team's Value Proposition

Teamwork takes considerable time and effort and may not always result in success. Given these facts, working in a team only makes sense if it results in valuable outcomes that are not otherwise possible. Identifying the benefits that a team will provide and the costs that a stakeholder will incur in garnering those benefits is the value proposition. Although traditionally, value propositions are developed for customer segments (Barnes et al. 2009; Rackham and DeVincentis 1998), science teams should consider both a general value proposition and a set of tailored value propositions for each of their major stakeholder groups—identifying the benefits for team members, funders, and others.

The value chain is one well-known and robust way of thinking about what the collaboration provides and how the value is created and can be enhanced for various stakeholders. It focuses on the activities that a team or organization performs and how value is added at each stage in the chain of activities that links the provision of raw materials to postdelivery maintenance of a finished product (Porter 1985). In manufacturing, the value chain starts with a supplier who provides raw materials. The collaboration then transforms these raw materials into some sort of product or service that is valued by a customer. The guiding question is "Why would a customer buy from your organization instead of buying the raw materials directly from your supplier?" Figure 25.3 shows a typical value chain including direct activities that transform raw materials into a product or service for delivery to a customer and the indirect or support activities that enable the direct activities to take place such as financing the direct activities and accounting for income and expenditures.

Fig. 25.3

The direct and indirect value chain



Translating the guiding question into a science team context, team leaders should consider questions such as, “In a world of open data, why would a customer/stakeholder read my team’s scientific publication instead of analyzing the data for herself?” These are not meant to be rhetorical questions. The answers should be concrete and point the way toward fulfillment of a clear and compelling value proposition. For example, the cross-disciplinary team could add value over and above an open data source by providing multiple perspectives, exercising rare data analytic skills, creating compelling graphics, and/or applying analytic software that is expensive or difficult to master. Any of these would add value for the reader at a lower cost than he or she would have to spend to duplicate these capabilities, so the reader should value the publication.

To take this a step further, leaders should consider whether researchers in the area of study could get more value from other kinds of information products. Leaders should consider whether it would add significant value if your science team also made the results available as presentation slides, as a YouTube video presentation, as an open access publication, or with the option to chat with the authors. Would it add value if your science team made the cleaned and annotated data and analytic codes available? Should these be posted to Github or would another repository add more value for stakeholders?

The team should also consider the needs of other customers/stakeholders such as researchers in other areas, students, alumni, funders, university administrators, and legislators. Could the team expand the kinds of customers/stakeholders it provides value for if the results were translated into a press release or otherwise made more media-friendly? How will the results be integrated into the team's communications strategy? How will they be featured on the website, in the annual report, and in social media postings? Could the materials be made available for use in teaching at the graduate, undergraduate, or K-12 levels? If there are multiple science teams that are addressing similar issues, those that find more ways to add value and reach a wide variety of stakeholders may find that they attract more resources (collaborators, students, funding, industry partners, space) and are more sustainable.

The science team also has to consider the costs of each of these additional information products and whether they ~~sh~~could result in a revenue stream. If these additional information products are provided for free, then the added value would accrue to the customer/stakeholder. If the science team charged for them then at least a portion of the added value could accrue to the team. Of course, team leaders should consider community norms and local regulations. Charging for information products may conflict with the terms and conditions set out by the funders or with university policies. On the other hand, if these information products are intellectual property that is owned by the university, then it may be the university that determines whether they can be made available for free.

25.6. Value Chain Analysis

Once important stakeholders have been identified and value propositions have been created for each, science teams can systematically look for opportunities to add value. Although scientific output is important, teams that focus solely on scientific publications may miss opportunities to add value in ways that will attract strong collaborators, good students, improved lab space, helpful industry partners, supportive university administrators, and additional funding. To help science leaders consider a wider range of opportunities, the value chain focuses on activities and systems, is divided into stages, and encompasses both primary activities that have an immediate effect on the production of products and services and activities that support and enable these activities. Value chain analysis consists of four steps: activity analysis, value analysis, evaluation, and planning for action (Van Vliet 2010).

Activity analysis involves identifying what the science team does including sub-activities. The focus here is on a step-by-step description of the team's workflow. For example, science teams create knowledge by engaging in research. They also disseminate knowledge by preparing publications and presentations, filing patents, delivering educational programs, authoring research proposals and white papers, and writing social media posts. They could import knowledge through arranging guest speakers, running a journal club, and organizing symposia or seminars. They could provide research support by maintaining collaborative writing groups, supplying mentoring, and providing data analytic services or data products. Each of these activities will involve sub-activities that should be enumerated, identifying the steps that are involved from the beginning of the process to its successful completion. To take a relatively simple example, bringing in guest speakers could start with identifying interesting potential speakers, determining a preferred schedule, contacting speakers, reserving rooms, asking for the talk title and abstract and speaker bio, advertising the event, making travel arrangements, providing appropriate swag, arranging additional meetings as desired, and ensuring that expenses are reimbursed.

A value analysis considers each of the sub-activities and identifies what each customer/stakeholder values in the way that this activity is conducted. For example, the early activity of choosing a speaker has implications for multiple stakeholder groups. Faculty team members likely value innovative speakers in areas that are relevant to their research. Student team members may value established speakers who can help build their professional network and provide mentoring. Development officers may value speakers that would appeal to wealthy alumni or other potential donors. Administrative staff likely value getting complete and accurate information in a timely fashion so that they can schedule rooms and make travel arrangements.

Science teams should then identify potential changes in primary or support activities that would add the greatest value for their customers/stakeholders and look for links among these to identify those changes that can have the largest impact. For example, setting a regular time and place for guest speakers can help faculty and student team members plan ahead and enable administrative staff to schedule rooms. Posting this on the team's website and tweeting details as they emerge can assist in communicating the event to alumni and potential donors. Science teams may want to develop a process for selecting speakers that results in a mix of innovation, experience, and areas of application. They could also create bundle of activities that maximize the value of each speaker by adding tutorial sessions for enhancing the understanding of new innovations, networking and mentoring opportunities with students, and alumni or donor activities such as lunch with the department chair.

This value analysis would be repeated for each step in each of the team's activities resulting in a large number of potential changes that could add value and fulfill the team's value proposition for its customers/stakeholders. Teams often overlook important activities that are not directly related to producing scientific results so should be sure to consider issues like what they do to recruit and retain the best people, how they motivate team members, how they keep up to date on new innovations, how they decide what new technologies and techniques to adopt, and how they collect feedback from customers/stakeholders. If these are neglected, then the team may have difficulty fulfilling their value proposition as they lose valued team members, decline in motivation, fall behind technically, and fall out of touch with important stakeholders in their environment.

Completing an activity analysis and a value analysis will result in a very large number of possible changes, not all of which can or should be made. The science team should identify those that would add a lot of value for important stakeholders and are relatively quick and easy. These should begin to be put into place immediately. There will also be a set of changes that are impractical or that are very difficult and would yield only marginal added value. These should not be pursued. The team can then prioritize the remaining changes in terms of their degree of difficulty and potential payoff. This list should then be used to create a concrete implementation plan. The plan should be achievable, provide step-by-step guidance, and show continual improvement so that the team remains engaged and enthusiastic.

Large teams and those that wish to grow can follow the same value chain process in planning their growth, but face additional challenges in fulfilling their value propositions. They must consider the impact of this growth on their current activities and identify new activities that may need to be added. In general, the larger and more complex the collaboration, the more elaborate and formalized the management structure and processes need to be to enable fulfillment of the team's value proposition. Many science teams find that their underdeveloped management structures, processes, and capabilities severely limit their scale and impact. Without adequate management, a team can seldom grow larger than a dozen members so cannot fulfill a value proposition that promises to address the most complex and difficult societal problems. Science teams that wish to scale up and increase their impact must develop management capabilities that are adequate to the task and many find that they need to embrace a division of labor with management responsibilities explicitly assigned to team members or provided by the team's university.

Regardless of how large or elaborate a science team is, to successfully fulfill their value propositions, a team must have in place robust management and collaboration plans that assign responsibilities to team members and specify management activities, processes, and reporting. These plans should identify who oversees the team's finances and accounting, what reports are created, how often they are created, and who receives them. Similarly, responsibilities and processes for human resource management must be determined. It should be clear who is responsible for hiring, supervising, evaluating, and firing personnel and what processes should be followed. Responsibility for compliance with legal and regulatory constraints must be assigned and it must be clear what these constraints are and how they are addressed. Teams must clarify who provides and maintains the information technology and at what service levels. Responsible for communications, marketing, and any revenue-generating activities must also be specified (Table 25.1).

Table 25.1

Steps in science team strategic management

Framework

Framework
Assessing the environment for the science team
Amount of existing competition
Number of customers
Number of suppliers
Substitutes
New entrants
Funders
Regulators
Managing stakeholders
Identify stakeholders
Analyze stakeholders
Level of interest
Level of power
Motivation
Developing a communication plan
Identify communication goal
Plan message based on motivation and value proposition
Determine communication timing based on interest and power and choose media
Fulfilling the value proposition
Perform a value chain analysis
Activity analysis
Value analysis
Evaluate options and plan implementation

AQ1

25.7. Conclusion

AQ2

Collaboration lies at the heart of the ongoing transformation of science. From small teams to teams of teams, to enduring centers, institutes, and consortia, scientific success increasingly depends upon good leadership. Few team leaders have easy access to appropriate management expertise, but some of the robust frameworks common to organizational studies can be adapted to provide guidance and help leaders of cross-disciplinary science teams achieve sustained success. This chapter has presented three such frameworks that can help team leaders: (1)

assess and influence the environment they are operating in; (2) develop their value propositions and communication strategy; and (3) improve their ability to fulfill their value propositions.

Team leaders can think broadly and systematically about their stakeholders and take action to improve their situations. They can identify competitors, customers, suppliers, substitutes, new entrants, funders, and regulators. Each of these can create an environment for the team that is supportive or potentially dangerous. By exploring this space, team leaders can think creatively about their products and services identifying new opportunities and partnerships.

Developing a specific set of stakeholders, determining their levels of power and interest, and understanding their motivations allows leaders to improve their value proposition for those that are most important and, therefore, make their environment more supportive. These value propositions can be combined with communication goals to craft effective messages that can be delivered in a timely fashion via appropriate media. Of course, it is also important that the science team be able to fulfill their value proposition. Teams can analyze their value chain identifying sequences of activities and processes, determining what important stakeholders value about each, thinking creatively about ways to add value at each step in the sequence, and taking action to implement appropriate value-adding changes, thus fulfilling the value proposition.

Using these robust managerial techniques increases a cross-disciplinary science team leader's ability to improve their situational awareness, manage stakeholder relations, and deliver clear value to those that the team depends upon. Organizational science has a long history of studying new ventures and providing tools to help them overcome the liabilities of newness and smallness. Armed with these tools, science team leaders can make better strategic decisions to proactively create supportive institutional contexts and the conditions for success.

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