Virtual Organizations as Sociotechnical Systems:

Exploring How Organization Scientists and Virtual Organization Leaders Can Collaborate*
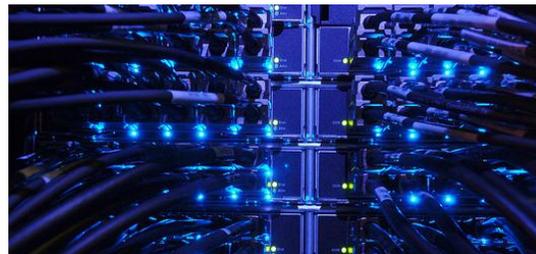
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EXECUTIVE SUMMARY

This report describes the results of a workshop held in Cleveland, Ohio in May of 2012 that brought organization scientists together with Virtual Organization (VO) leaders to address the challenges facing managers of VOs, key insights from research on VOs, and whether it is possible to build a sustainable community among organization scientists and VO leaders. Both organization scientists and VO leaders were enthusiastic about collaborating, but there were challenges:

- ***Challenges to collaboration between VO practitioners and organization scientists***. One challenge involves the translation of organization research findings. VO leaders want clear, simple, and validated answers to their problems, while the complex and highly contextual findings from organization science could fill volumes. Another challenge involves misalignment of goals. VO leaders want actionable insights into the issues important to their organizations, while organization scientists want to understand how organizations work in specific situations and in general. Despite common ground, there are misconceptions and misalignments of interests among the organization scientists and VO leaders.

- ***Challenges in potential relationships between VO practitioners and organization scientists.*** Five relationships appear possible:
    1. *Engineering:* Organization scientists provide formulaic "cookbook."
    2. *Research:* VO leaders provide research setting.
    3. *Education:* Organization scientists teach a custom curriculum for VO leaders.
    4. *Consultative:* Organization scientists study specific issues for VO leaders.
    5. *Collaborative Research:* Joint research that addresses VO leader needs and that is academically publishable.

- ***Challenges going forward.*** Four themes emerged that require attention:
    o *Evidence-based management*: translate general findings to local contexts.
    o *Benchmarking & best practice*: documenting what works in different contexts.
    o *Embedded researchers*: finding the appropriate organization scientists.
    o *Executive education*: developing a specialized curriculum.

This report addresses these findings, characterizing the leadership challenges facing virtual organizations, summarizing the role organization science should play, outlining the tensions involved in bringing VO leadership and organization science together, and concluding with ideas for a way forward.

"…the same power of science which has so amazingly increased the productive
capacity of mankind during the past century will be applied again,
and the prizes of industrial and commercial leadership will fall to the nation
which organizes its scientific forces most effectively."
- Elihu Root, 1918, address to the National Research Council[1]

Introduction

Elihu Root in 1918 wanted to apply industrial management to the process of creating scientific knowledge. The nation's competitiveness still depends on its ability to marshal scientific knowledge for innovation and discovery, but much has changed since 1918. Scientific and engineering research often takes place across distributed, collaborative research centers (NAS 2005). These "virtual organizations" or VOs, consist of geographically dispersed individuals who function as a coherent unit. They are hybrids of traditional and novel organizational structures, nested social networks, transitory roles, and ever-changing, "drifting" arrangements (Lee et al 2006). VOs leaders are more likely to be successful if they can master the particular challenges VOs bring (Cummings & Keisler 2007).

Organization scientists have learned a great deal about VOs from perspectives including social psychology (e.g., Cummings and Kiesler, 2005), information systems (e.g. Ribes & Finholt 2009), software engineering (e.g., Howison & Herbsleb 2011), and social studies of science (Bowker et al 2010). NSF's Virtual Organizations as Sociotechnical Systems (VOSS) program has funded dozens of exemplary research projects. Unfortunately, VO knowledge remains too diffused and scattered. The leaders of science and engineering research centers need advice on benchmarking VO activities, guidance on best practices, and improved managerial competence required by VOs. Ad-hoc networking among VO directors is not adequate to improve management to a level required for VO success.

Leadership Challenges of Virtual Organizations

Virtual organization leaders typically rely on trial-and-error learning. VO leaders follow management practices based on their successful experiences with other science projects, and most leaders have the professional experience to coordinate VO activity. They proceed based on experiences they have had, and do their best to coordinate complex and dynamic activities. This can be quite effective, but few leaders have comprehensive experience and there is little to guide them in deciding what might work and what will not. To establish, coordinate, and sustain a VO requires information on successful strategies and tactics, on the "best practices."[2] VO

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[1] May 29, 1918 meeting of the Advisory Committee on Industrial Research of the National Research Council, as reported in *Science*, Vol. XLVIII, No. 1248.

[2] The term "best practice" is a euphemism to describe "good practice." Neither the participants nor the authors claim that specific practices are widely practiced or demonstrably "best."

leaders wish to "benchmark" their activities against their peers, while recognizing that VOs are not all the same: a wide array of VOs can be found. As one workshop participant noted:[3]

> "One [model] is where we actually have a central pile of money and … a distributed set of activities going on. I'd almost consider it a virtual project. And then you have other [models] that actually have goals, yet [people are] working together because they see some common good from doing that. They found their own way there. These may be two different things."

VOs can differ on their funding bases, as indicated in this quote. VOs can also be organized in different ways, and some situations bring unique challenges and require idiosyncratic practices tied to different stages in their evolution. One participant noted:

> "I think as a new organization gets started... you get a large project going and it's sort of like here's the first paycheck. Go! It would be good, I think, to have a little bit of help or at least a document for the managers or the organizers of [this] project to go through. [The leader might] say "Oh, the first thing I should do is probably think about measuring the organization. Wait a second, I don't know anything about that!" We talked … about how an organization started – infrastructure – and how you identify [key employee] positions; how you communicate effectively to your stakeholders. As you get established, how do you transition from a growth phase to a stationary phase?"

Sustainability of a VO was a common concern among VO leaders. As one participant noted:

> "We had a discussion of sunset: what our existence criteria might be.[4] That probably should be pushed out into the community. I think it would be very useful. It comes back to the stages. It's basically breaking the life cycle, or terminating it, or at least understanding where you are. Existence criteria can apply. Some virtual organizations want to continue but can't because funding goes away and programs go away."

The question of long-term funding weighs heavy on most project-oriented VOs throughout their existence. A VO doing important work in a particular area can face insecure funding, and its leaders are called on to demonstrate the value of their organization. Many VO leaders can monitor operations, but have difficulty answering questions about how many people use their resources, how many users they have supported, whether they have met milestones. Some outcomes traditionally accounted for by particular metrics (e.g., measuring scientific impact by citation counts and documentation of the research that the VO enabled no longer work very well to convince the full array of stakeholders. The array of stakeholders has grown, and might include scientific disciplines, individual researchers, employees, universities, local communities,

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[3] Where possible quotes from participants are included. These have been edited to make the written prose more easily understandable, and in all cases to preserve the intent of the speaker. Direct transcripts are available on request, but the identity of speakers remains hidden.

[4] "Sunset" in this context means the practice of establishing at the beginning that the endeavor will end at a particular point unless specific action is taken to continue it. This is in contrast to the practice of setting things up so they continue in perpetuity.

and national funding agencies. Each stakeholder group might look for different measures. VO leaders are challenged to understand, measure, and demonstrate value to different stakeholders, remains a critical issue to VO leaders.

VO leaders are aware that they must attend to some stakeholders, such as participants in the VO. Yet even in this case VO leaders voiced concerns about attracting, training, and retaining appropriate participants. VOs operate with geographically dispersed teams who must continually balance VO goals with the reality of their "regular" organizational activities. VO activities naturally take second place to the demands of organizations that provide the primary paychecks or job security for participants. VOs are characterized by geographic dispersion, indirect reporting relationships, and partial commitments. VO leaders must often manage participants without direct control over them. It can be difficult to maintain motivation and morale through appropriate rewards. Most VOs lack informal communication channels to exploit peripheral awareness, which is important (though often overlooked) in traditional organizations. VO participants often spread percentages of their time across VOs. A given participant's time in a given VO might be as low as 10% more than 50%. How much time is "enough" to provide a contribution? How much time is "enough" to create organizational identification and loyalty in the participant? Should VO leaders establish minimum levels of time commitment for participants? If so, what should the minimum be?

The VO culture is a new kind of organizational culture, and VO leaders are required to manage effectively in this culture with limited preparation for the challenges it brings. VOs sit outside traditional organizations. They lack the clear supervisory relationships and explicit control mechanisms of traditional organizations. VO communities to date have often been voluntary, with goal-oriented motivation that is susceptible to goal incongruence and considerable gray area regarding organizational authority. Workshop participants identified challenges in establishing appropriate career paths, which is one of the fundamental responsibilities of organizational leadership. They look forward to learning from each other, and were eager to hear about success stories from other VOs. They hoped that such stories could form the base for benchmarking and best practices in their VOs. They were seeking help in coordinating virtual activity, in communicating what their VO does, and demonstrating the value of their VO to stakeholders. They identified human resource management issues particular to VOs. Most noteworthy, they looked to organization scientists for guidance. Getting sustained attention from academic researches can be tricky; the academic reward system does not always match the VO leader's reward system. The next section explores research on virtual organizations, laying the groundwork for the main contributions of the workshop and steps for moving forward.

Research into Virtual Organizations

NSF has invested in many studies of virtual organizations. These studies cover a range of intellectual perspectives within the broad rubric of organization science. This work builds on decades of prior effort in organizational theory, behavior, design and management. Not

surprisingly, the work in VOs identifies well-established trade-offs and tensions that accompany organizational design decisions and management practices. Organization science has in some cases focused on the particular needs of collaborative scientific organizations (e.g., Cummings & Keisler 2007 and Ribes & Finholt 2009), and key ideas from such research provides some clues on how to proceed.

One can argue that the timeless lessons for organization leaders (e.g., Galbraith 1977, Mintzberg 1981) are all that VO leaders need, but this is not a convincing argument. As the previous section suggests, VOs have some features that are quite different from traditional organizations. VO leaders would like nothing more than to be able to pick up time-tested and trustworthy advice from organization science and simply apply it to their challenges. It has not been that easy to do. At a minimum, the contemporary work on business models (e.g., Osterwalder et al 2005) suggests that VO leaders must come up with novel ways to bring resources to bear on organizational strategies. Moreover, research on interorganizational governance (e.g., Dyer & Singh 1998; Helper et al 2000) suggests that collaborative, network forms of organizations (Moller & Halinan 1999; Yoo et al 2006), and distributed team collaboration (Boh et al 2007) bring new challenges. There is no "one-size-fits-all" solution to the challenges facing traditional organizations, especially high reliability organizations (Weick & Sutcliffe 2001), organizations that face significant product innovation (Baldwin & Clark 2000), organizations engaged in research & development (Thamhain 2003), or attempting to capitalize on "open" innovation (von Hippel & von Krogh 2003).   As attractive as the "We already know all we need to know about virtual organizations" argument might be, it is not a convincing argument. Much additional work remains to be done.

In addition, VOs provide attractive opportunities for organization science. One of these is to explore in greater detail the notion of "infrastructure" and the role it plays in economically and socially important activity (e.g., the development of infrastructural software, domain-specific software, supercomputing technologies, and technological standards). Another is to explore the changing nature of collaboration enabled by infrastructural innovation, especially as seen in work that suggests that some infrastructures behave as complex adaptive systems that continually changing the way they do things (Hanseth & Lyytinen 2010). It becomes possible to put some specificity on the concept of "emergence," which has been articulated frequently but seldom handled seriously or consistently in the organization science literature. VO leaders need to develop robust routines, but they must also be flexible and adapt quickly to significant changes in their work and their environments. It is doubtful that advice helpful to traditional and relatively stable organizations will meet the needs of the VO leadership. Rather, it appears that VO leaders need guidance on development and implementation of "metaroutines" (e.g., Eisenhardt & Martin 2000). This is but one suggestion of the direction organization science might take with VOs.

The organization sciences have been working on related issues, including leadership (Miner 2005), business process management (Grover & Markus 2007), change management (Burnes 1996), and virtual teams (Martins et al 2004). This report does not suggest that organization science must be completely overhauled. However, organization science must reach beyond the

constraints of traditional organizations to embrace what is new and interesting about VOs. There is an opportunity for organization scientists to study and make sense of complex organizational phenomena (Astley & Zammuto 1992), and to make more prescriptive important concepts such as March's (1991) distinction between exploratory and exploitative learning; Christensen's (1997) characterization of the "innovator's dilemma"; Weick & Roberts' (1995) description of mindfulness; and Boland & Tenkasi's (1995) perspective making-and-taking as applied to different organizational communities. A particularly interesting set of opportunities surrounds the challenges of software development, including software risk management (Lyytinen et al 1998), requirements elicitation (Hansen et al 2008), IT project management (Mahring 2002), distributed software development (Herbsleb & Mockus, 2003), and software development methodology in general (Hirscheim et al 1995; Berente & Lyytinen 2007).

VOs embody novel ways of organizing. The lessons of traditional organization science will certainly apply in some cases but not in others. To meet the needs of VO leaders, it is essential that organization science identify and account for the special features of VOs, distinguishing between those established realms of organizational advice that will work in VO settings and those that will not, and developing new advice special to the needs of VOs. This effort is already underway; it does not have to be started anew. It must, however, be accelerated. A particularly interesting genre of organization science is focused on collaborative research centers. The unique challenges of such centers are particularly important (Ribes & Finholt 2009), as are the way they are organized at present (Lee et al 2006), and the different features they exhibits (Bos et al 2007).

A growing body of research focused on such centers has been supported by NSF's VOSS Program, including: evaluation of best practices for such centers (Knobel & Bowker 2011); understanding the design and management of centers (Berente 2010); the drivers of project success within such centers (Wilkins-Diehr 2009); and the development of center leadership talent (Finholt 2009). Other relevant studies include those by Ribes & Finholt (2009) and Cummings & Keisler (2007) that focus on particular projects that exhibit important VO characteristics, as well as research into fields of scientific or scholarly work that examine the way collaborative science takes place (e.g., Binz-Scharf 2009; Edwards 2009). Thus, research into VOs is intensifying and more organizational researchers are gaining experience in this domain. However, there are still some fundamental tensions that exist with respect to impacting and informing practice from this research. Next we will briefly describe two of these tensions, followed by some ideas for moving forward.

The Tensions

VO leaders could benefit from explicit guidance provided by organization scientists working on VOs. However, there are tensions to be addressed. We provide two representative examples of the discussion during the workshop, one involving translation of organization science into useful guidance for VO leaders, the other involving missed connections.

Tension 1: Translation of Organization Science

Organization scientists understand that VO leaders need guidance, but they locate their expertise in their published literature and tie descriptions of "what is known" to published articles, collected volumes or books that explain deep expertise in particular aspects of virtual organizing. VO leaders seek actionable conclusions, summarized findings that they can act on. Organization scientists proved apprehensive at turning their de-contextualized findings into advice, while VO leaders proved apprehensive about the time commitments involved in engaging the literature directly. An exchange between two participants (S1 and S2) captures this well:

> S1: I actually wanted to hear about what topics were well understood and which are not. I don't study virtual organization research at all. I don't read any papers on it. I might be much more motivated now after being at this [workshop] but I'm just doing whatever the next job is.
> S2:   You need the abstracts …
> S1:   Yeah. No, I want somebody to read the abstracts and tell me what I need.

Another participant captured this sentiment:

> "A matrix might be useful so practitioners. This is my problem. Researchers say, "This is your solution." This is the book. Preferably it's an abstract, right? The Cliffs Notes version."

VO leaders asked the organization scientists for recommendations for books they could read. After receiving a flood of suggestions in return, the VO leaders described the time constraints they face and asked which would be the "best" book to read. The organization scientists could not reach a consensus on this and the discussion died.

VO leaders recognized that organization scientists would bring experience from a wide variety of projects over long time periods:

> "Basically it's wanting to hear, in some kind of nutshell, [from] people who have studied very many organizations over long periods of time, the state of practice. What have people learned? What can be beneficial to someone who has never gone to management school and is now, managing large amounts of people and large sums of money. It's interesting to hear that other people have approached things in the same way. [This] leads me to think there's a reason for that. And I'm sure you all know what that is."

Nevertheless, organization scientists resist constructing the summaries wanted by VO leaders. A VO leader suggested the summary was not intended to capture all that the organization scientist knows, but to determine what each organization scientist knows; to identify experts in

particular areas. This leader, referring to an organization scientist working on virtual team collaboration, said:

> *"We need experts in the world. I don't know if any of the VO practitioners knew this before I just said it. [An expert is] here in the room with us. He knows this stuff very well. Knowing [that he is] an expert on this is part of the human connection. We want to have some of the content [and a] directive that these are the people who study this stuff and know this. We need to contact them."*

The VO leaders want to identify the appropriate experts in the organization science community and know at least some of what those experts know. The organization scientists are somewhat reluctant to translate what they know into simple guidance for VO leaders, not because they want to keep that knowledge to themselves, but because they are reluctant to make complicated realities into overly-simplistic stories. This is an important tension, but it is overshadowed by an even more fundamental tension in alignment of interests between the goals of organization scientists and those of VO leaders.

Tension 2: Alignment of Interests

VO leaders are understandably concerned with local goals, especially the pursuit of their scientific mission, and seek guidance to help achieve that mission. Organization scientists who hear this from VO leaders move quickly to the domain of her expertise and their own research questions, and often to the higher level of the context in which a given VO operates. A disconnect appears immediately. There is no disrespect in this disconnect: VO leaders and organization scientists find the perspectives of their colleagues interesting, and did not question the truth, interestingness or appropriateness of each other's questions.

As an example of this, a VO leader asked about management challenges said his VO should last longer than his project funding in order to accomplish more in service to science. Organization scientists immediately responded with a discussion of institutional theory regarding the tendency of professional staff in organizations to pursue their organization's long term existence. The organization scientists moved the level of analysis from beyond the challenge facing a single organization (the one the VO leader led) to the larger question of innovation systems and organizational ecologies. This ended with an argument that the desire for organizational persistence can lead to organizational ossification and reduce innovation in the system. This was not what the VO leader had in mind.

Another organization researcher suggested that the VO leader's problem was related to institutional power, and asked why funding agencies might prefer to let all projects fold rather than try to sunset ineffective or superseded ones. The discussion quickly turned toward the political and organizational positions of project officers in the funding agency who might prefer that all projects (like the VO leader's project) have clear end dates and re-competition in order to avoid spending the political and social capital required to close particular projects and continue others. Both responses from organization scientists were relevant to research on VOs, and the

VO leaders understood the issues involved. But neither response helped the VO leader determine what he should do with the problem he was facing. In short, the VO leader was describing his interests, and the organization scientists were describing their interests. The two sets of interests were not aligned.

The workshop proved that both VO leaders and organization scientist can talk to each other. It also showed that they can talk past each other.

A Way Forward

> *"[My organization] is a virtual organization because there is no other way to bring together all the talent, experience, and resources to be successful. The organization has a lot of experience in virtual organizations, but we figure out a lot as we go. It would be useful for us to learn vicariously from the experience of others, which I think was one of the goals of the workshop. But I am unsure how to proceed from here."*

It is clear that VO leaders would value guidance about organizing: figuring things it out as they go along has worked pretty well, but it probably will not work as well as virtual organizations become more complex and important. VO leaders showed genuine interest in organization science. They see the literature as inherently interesting and as a source of stories about how others have dealt with situations similar to those they face. Most important, they see the literature as a source for the creation of something they would very much like: "management in a box."

The models for interaction between VO leaders and organization scientists emerged:

- *Engineering relationship* – This is basically a professional relationship in which organization scientists provide VO leaders with 'off the shelf' answers. This is simple and actionable, but runs the risk of superficiality and mistakes that can be made with decontextualized knowledge. It is not clear how many good organization scientists wish to participate in such a relationship.

- *Research relationship* – In this model VOs serve as subjects for organization scientists to study, thereby contributing to organizational literature is the primary goal. Interesting or actionable findings is a possible side effect. This will probably produce thorough and rigorous research, but the results might not be actionable by VO leaders. It is not clear how many VO leaders wish to participate in such a relationship.

- *Educational relationship* – Organization scientists serve as educators of VO leaders in workshops or classes, focusing on a set of relevant theoretical and empirical findings. This might produce deeper understanding of relevant research among VO leaders, as well as improved understanding of what VO leaders need to know among organization

scientists. It would require significant investment in curriculum development and strategies to make it work, and a suitable self-sustaining model must be created to support it over time.

- *Consultative relationship* – Organization scientists engage in consulting work to assist VO leaders in solving organizational problems. Experienced consultants among the organization scientists are likely to provide customized and actionable assistance, but the direct costs could be high for VO organizations the opportunity costs could be high for organization scientists who are rewarded mainly for academic publication.

- *Interdisciplinary research collaboration* - VO leaders and organization scientists are full partners, answering questions through study that produces findings that are actionable for VO leaders and academically suitable for organization scientists. Relevant theory might be extended through empirical work. The interests of both groups might be served, but coordination of such a strategy can be difficult as past experience with this model suggests.

Each of these models poses promise and problems. All have been tried in one way or another, and all have shown that there is no "one-size-fits-all" solution. To the extent that formulaic knowledge exists at all, it often does not work very well in specific situations. Context-specific responses are likely to be more beneficial, but generally come with higher costs in time, commitment, and monetarily. Who bears these costs? Neither VO leaders nor organization scientists are likely to take on these costs when resources are already stretched thin. The challenge for coordination between these communities is how they better align their interests and goals. It is tempting to say that the challenges are equal on both sides, but the workshop suggests that the most serious challenge is in providing *actionable* knowledge for VO leaders.

Management knowledge for VO leaders must provide guidance on how to lead in innovative contexts. The self-interested promises of "management gurus" are relevant to only circumstances that can be captured explicitly; they tend to fall apart in the many cases where knowledge of circumstances is tacit (Nonaka 1994). Context-sensitive knowledge is difficult to convey to "rookie" leaders and, in many cases, to experienced leaders (Flyvbjeg 2003). Effective leaders learn by comparing normative models of action with knowledge from experience that is built up over time (Schön 1983). An actionable body of knowledge should involve interpersonal exchanges among experienced leaders as well a variety of descriptive cases that deal with management problems *in situ* (Flyvbjerg 2003). These are complementary; each can contribute to the reflective practice of VO leaders. [5] Strategies for providing management knowledge for VO leaders must consider evidence-based management, benchmarking and best practices, embedded researchers, and executive education.

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[5] The proposed research collaboration network brings these three together and leverages them to inform practice and preparing collaborative research center leaders to help each other tackle the complex problems they face.

Evidence-Based Management

"Evidence-based management" describes managerial practices established as "good" through rigorous research. It implies the limits of broad theories and knowledge for solving organizational problems. The term has been used for over twenty years in organization science, but the concept has been applied only to rudimentary managerial problems with little translation across organizational contexts. Real organizational problems are complicated if not complex, and are seldom amenable by general remedies. VO leaders seeking to apply organization science must bring together multiple different viewpoints, and make decisions based on incomplete knowledge. Organization science provides a vocabulary and frameworks for sense-making: the first step in solving problems and pursuing opportunities. For example, research on technological entrepreneurship and new venturing can help VO leaders think about the shift from project to organization. Research on the management of teams and organizing for innovation contains descriptive case studies that might provide lessons for VO leaders. There is seldom a single "right" answer, but empirically-grounded organization science can offer examples for the VO leader to choose from and adapt for local application. The important question is two-fold: what evidence is there to support the claim that a given management practice will produce good results *in general;* and what evidence suggests that it will work in *this particular situation?*

Benchmarking and Best Practice

Two questions confront most organizational leaders: how well are we doing, and how can we improve? The former is tied to an old maxim, "You cannot manage what you cannot measure." Of course, it is helpful to have precise measures, but there is little evidence-based research that shows that it is impossible to manage what cannot be measured. On the contrary, good managers deal effectively with difficult issues such as morale that have few precise measures. The latter – the desire to improve – frequently leads directly to the assumption that there are identifiable "best practices" that can be followed to achieve improvement. This is not a crazy assumption: experienced center managers use their tacit knowledge about what works and what does not. Such lore is often described as "best practice" but it is not clear how widely any given schemes are practiced, and there is usually little to back up the claim that the practice is "best" in any serious sense of that term. For both benchmarking and best practice, there is considerably more hope than proof in the offer. Benchmarking and prescriptions of best practice are desirable. VO leaders know that either or both would make the VO leader's job easier. The problem is not with the *principle* that benchmarking and best practice would be useful; everyone agrees with this principle. Rather, it is difficult to come up with benchmarking and prescriptions of best practice that meet the "evidence-based" test described above or the practical utility demanded of VO leaders.

Organizational science has the potential to help with this challenge. In fact, organization science has focused on benchmarking and best practice in several ways. The field of organization science itself is concerned with measurement – what is often referred to in research circles as "operationalization of variables" used to study organizational phenomena. Moreover,

organization scientists have shown interest in "critical success factors," and have shown that organizational leaders practice their craft in ways that improve organizational performance (Szulanski 1996; Malone et al 1999). Guidance on benchmarking and best practice, if it could be provided with confidence, could give VO leaders a place to start when confronting challenges, even taking into account the difficulty of transferring of benchmarking and best practice from one organizational situation to another. Organizational resistance to change and other "sticky" behaviors are common in organizations (Szulanski 1996; Wagner & Newell 2004). "Key performance indicators," often called KPIs, are vital for traditional organizations, and there is good reason to believe (as VO leaders do) that KPIs are important to VOs. Improving KPIs and providing evidence when, where and how they work well (or not) would help VO managers considerably, and this might well be within the ability of organization science.

VO leaders are increasingly called on to accept that benchmarking and best practices for their organization are available, and to pursue them when they find them. Benchmarking and best practices are "the done thing" in organizational leadership circles, and VO leaders pursue them because they are expected to do so. If benchmarking and best practice are common sense VO leaders with common sense are probably already pursuing them. Yet, if the organizations and institutions that VO leaders are part of require stupid things, as some VO leaders claim, following common sense seems impossible. Best practices can be counter-intuitive: for example, research shows monetary incentives are ineffective at increasing creativity, yet many organizations offer monetary incentives to spur creativity (Amabile 1996). It is politically risky for any VO leader to say he or she refuses to pursue benchmarking and best practice, but there is little guidance to go on in this area.

Benchmarking and best practice recommendations have seldom been evaluated in terms of decades of organization science research. They should be evaluated in order to ground them and change them as required. If nothing else, organization scientists should provide guidance on what benchmarks and practices are backed by evidence and which are not. It is useful for VO leaders recapitulate their experience in light of benchmarking and best practice recommendations. Well-constructed case studies can offer VO leaders the opportunity to consider organizational options. For example, software production can be explored by cases that describe different models for managing software work, together with arguments about why such models are adopted and what they are for. To the extent that the science and engineering work receives public funding, demands for benchmarking and best practice will grow. Organization scientists can and should help with this challenge.

Embedded Researchers

VO leaders were interested in working with organization scientists in in-depth, rigorous research. As one workshop participant explained:

> "Find an individual, perhaps a young researcher, maybe post degree or perhaps even a late doctoral student that might be a visiting scholar. Suppose you match that [person] up with [my VO] and [that person] visit our sites for a week or two [and see] the various

components of project activities: do interviews, do whatever research you'd like to do and two. Then do two things: identify issues where we have a problem [that] we don't quite know how to solve, and then assist or at least recommend; and secondly, prepare talks [to acquaint] people with techniques, vocabularies, concepts and [such] to raise awareness. Whether [people] use [this information] or not is another question. From the point of view of [my VO] I have a feeling that [people] would be favorably disposed. We're all about research and fostering collaboration. It probably wouldn't [take] much time. A person to do this [as an] embedded researcher or a visiting schola might work very well. And certainly, [the researcher would] gain something from that."

This suggestion was received well, with organization scientists claiming this arrangement could be quite valuable. Very junior people such as undergraduate students might even be used for this purpose, not because of their expertise, but because they can ask sensible questions. As one participant noted:

"The best undergraduate and master's projects I've worked with [have] had big impacts on the organization. [The] student's value to [the] organization is they ask stupid and obvious question and propose half-baked solutions that prompt ideas and discussion. They ask the faculty questions and [even when] they do a bad translation [they have a] huge impact on organizations [that] don't have inflated expectations.

Another participant said, "The value is not in consulting but the conversation." Whether junior people can be of much help remains an open question, but it was widely agreed by participants that senior experts can offer substantial help to VO leaders. Senior experts in this context include organization scientists, faculty, as well as executives who return to universities late in their careers for executive doctorate degrees. Such executive doctoral degree programs are becoming more common in institutions such as Case Western Reserve University's Weatherhead School of Management and Syracuse University's School of Information. The embedded researcher strategy can bring positive results and merits further exploration.

Executive Education

Workshop participants agreed that formal, targeted education for VO leaders could be worthwhile, both to strengthen the skills of current leaders and prepare the next generation of VO leaders. Evidence supports this view. Formal executive education began in the late nineteenth century, and was extended dramatically during World War II to help manufacturing managers shift to wartime production (Crotty and Soule 1997). Between 1890 and 1940 knowledge about how to run industrial organizations expanded, especially regarding the multidivisional (M-Form) organizations pioneered in the US automobile industry in the early 20th century (*c.f.* GM CEO Alfred Sloan's memoirs, 1957). Chandler (1962) and Williamson (1975) enshrined this knowledge, and reinforced the belief that managerial knowhow could be *taught.* Executive education grew as a result of globalization and the rapid scaling of industry between 1960 and 1990 (Vicere 1989), and expanded further in the 1990s as the digital revolution, cost-cutting, business process reengineering, mergers and acquisitions, and new partnerships and

alliances became common (Conger and Xin 2000). Executive education today is driven by increasing turbulence from competition and technological change, with increasing focus on the skills, tactics, and mindsets required to help business leaders cope with complex change (Ready *et al.*, 1993).

Contemporary executive education has moved toward new technologies and new ways of organizing production that enable executives to transform and revitalize organizations and keep pace with continuous innovation (Crotty and Soule 1997; Clegg and Smith 2003). Participants explore organizational issues through collaborative sessions with veteran faculty members and other senior executives. Senior executive experienced in leading innovation and change is leveraged, touching every aspect of organizing, transcending disciplinary silos of "function" (*e.g.,* accounting, marketing, finance), and emphasizing multidisciplinarity (Pfeffer and Fong 2002). In the words of two executive education leaders:

> *"Learning occurs where concepts meet experiences through reflection. The faculty may need to teach, but mostly the participating managers need to learn. In other words, they are not vessels to be filled with knowledge, but active learners who must be fully engaged in the process… [executive education involves] confronting old beliefs with new ideas… managers have at least as much to learn from each other as they do from us." (Mintzberg and Gosling 2002, p.66)*

The objective is to develop executive skills in leadership, the administrative mindset, and human and organizational values (Doh 2003). The best programs are tailored to particular industries and organizations, organized around research into issues of concern (Tushman *et al.*, 2007). Clinical or "action" components allow executives to collaborate, identifying and solving real organizational problems by applying new ideas (Pfeffer and Fong 2002). Executive education recognizes the importance of face-to-face learning (Mintzberg and Gosling 2002), a finding consistent with research on scientific collaboration that shows the importance of early face-to-face engagement for subsequent "on-line" learning components (Olson, et. al., 2008).

A workshop participant with experience in executive education said:

> *"I find [it effective] to [use] executive education. [It is] useful when people come to executive class with problems in their mind. 40+ year olds [that] hear the idea [that] I've translated from research [benefit from this] engagement. They engage. This is what I was thinking: let them try to analyze this problem. They're motivated."*

Given this, it is tempting to believe that VO leaders could benefit directly from executive education provided by business schools. The problem with this scheme is that the materials developed for business-oriented executive education programs do not map onto the needs of VO leaders. Many VO leaders do not see themselves as "managers," as on VO leader participating in the workshop noted:

"The vast majority of scientists have no interest in becoming a manager. They may be interested in succeeding at managing things, but … "

Individuals who create VO centers sometimes are not the right people to maintain or sustain those organizations, as one workshop participant explained:

"Often the PIs that have the right personality to rally a large community to launch one of these large centers, [do not have skills] that translate to becoming a good manager for a large project."

There are many differences between what VO leaders need and what traditional executive education provides. Among other things, traditional executive education focuses on organizations in competitive industries, while most CI centers focus on pre-competitive work in the basic sciences and engineering. Also, most executive education is aimed at organizations with command-and-control structures and clear lines of authority, while VO leaders manage people (e.g., skilled researchers) who operate like franchisees rather than employees, who consider referent authority from substantive knowledge to be more important than formal authority, and might have secure employment (*e.g.,* academic tenure). VO leaders need executive education materials developed for the challenges they face if executive education is to work.

Conclusion

"You cannot have a curriculum unless [you] know something about [the problem]. The problem] cannot be [understood] in a single project, but over a long period of time. [It is necessary to] know a certain body of knowledge. We have something to offer you. We do [this work] all the time. Yet we do not expect to get benefit right away. We recognize [this is] a long-term scientific endeavor. We need [this] kind of movement, effort and investment. I don't think it will happen from a single project or RCN."

VO leaders need guidance on how to do what they are trying to do organizationally and institutionally. They believe organization science might help them. They are willing to listen and eager to learn, but abstractions of organization science are not of much use to them. They understand and appreciate theory (among the academics, theory is part of what they do), but they are responsible for making things happen in the VOs they lead. In contrast, organization scientists want to know more about the subjects of their research. VO leaders are likely subjects for organization science (at least as practiced by the workshop participants) and there was a good deal of "access grubbing" going on as organization scientists attempted to establish entry to the VOs represented at the workshop. Both sides were interested in the work of the other, but generally from the perspective of their own interests. This is no surprise; it merely points out the need to align the interests of the VO leaders and the organization scientists.

A crude but workable exchange structure might be emerging: VO leaders need answers from organization scientists and are willing to provide access to their VOs and insights about their enterprises to get those answers. Organization scientists want insights about VOs and are willing to help VO leaders in order to get those insights. This has problems, but the exchange structures it might be enough to build future efforts. This workshop brought together the willing; people who *want* to believe that collaboration will be useful. Future workshops will explore the challenges of engaging those who are perhaps less willing.

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