RESEARCH & DEVELOPMENT

CLEAR (Communicate Lessons, Exchange Advice, Record) Technology Transfer and Metric Building

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16. Abstract

Managing knowledge is centered on deciding what is to be shared, by/with whom, and how to share it. Ultimately, organizational value is produced when the shared knowledge is used and re-used. Consistent value is created when there is an atmosphere of mutual trust, when employees are motivated to share knowledge, and when there is a systematic process to find existing knowledge, create new knowledge, and communicate with others on a simple to use platform.

In order for organizations to achieve sustained growth in an efficient and effective manner, knowledge sharing practices are uniformly believed to be an integral ingredient. Creating a knowledge sharing culture is never trouble-free and usually requires a great deal of effort on the part of those who are charged with developing and leading the initiative. This research is an effort to catalogue many of the best practices from previous knowledge management (KM) program successes as well as the several barriers and risks to the endeavor. Ultimately, a successful program will depend upon four overarching things:

(1) Employees must be motivated, encouraged, and rewarded so that they willingly capture, disseminate, and generate useful knowledge.
(2) The organizational structure must be designed to facilitate transparent knowledge flows, processes, and resources so that a general culture of continuous learning and sharing exists.
(3) Organizational strategy, goals, and expectations must be clearly communicated and continuously supported by the leaders of the organization.
(4) Technology must be purposefully integrated into existing social knowledge networks providing a platform that employees are comfortable using.

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EXECUTIVE SUMMARY

For the NCDOT CLEAR program (**C**ommunicate **L**essons, **E**xchange, **A**dvice, **R**ecord) to be effective, the focus will need to be on understanding the senders and receivers of knowledge, focusing on the structure and content of that knowledge, and designing the appropriate medium(s) with which to transmit the knowledge. This research project was organized such that the initial sections offer readers with little past knowledge management (KM) experience an overview of past knowledge management initiatives, including a presentation of key definitions and best practices. The report discusses various aspects of individual and organizational learning and how these relate to the CLEAR program. Likewise, the impact of organizational culture is explored so that KM lessons learned from both for-profit and non-profit organizations can be used to assist in the development of an appropriate NCDOT program.

In summary, the general conclusions of this research are as follows:

1. Many KM initiatives fail to persist beyond the launch or early stages of program rollout. There are several reasons for failure that the NCDOT must avoid in order to ensure the long-term success of the CLEAR program. Top management support, appropriate information technology (IT) platforms, and an appropriate structural approach to the initiative are keys to success. The long-term success of the CLEAR program will be heavily dependent upon an organization-wide approach to development, launch, and maintenance of the initiative.
2. KM programs are organic initiatives that can only be sustained if the programmatic environment is supported at both the individual employee (bottom-up) and upper management (top-down) levels. This can only be achieved by developing clear and

transparent communication channels that regularly promote – both formally and informally – the operational and organizational value of the CLEAR program and why the NCDOT is doing it.

3. A culture of knowledge sharing must either be developed or enhanced at the NCDOT in order for the CLEAR program to be successful. Any lack of an existing sharing culture will slow the growth of the program. Communication and organizational barriers must be eliminated or reduced to the greatest extent possible to facilitate programmatic success. Employees and managers must be appropriately empowered and socialized to understand the importance of knowledge sharing (both successes and failures) to both the individual employee, their respective division, and the organization as a whole.
4. The greatest barriers to CLEAR programmatic success are likely to be internal cultural resistance and technological roadblocks. While IT problems can be largely anticipated and mitigated, the internal cultural resistance will be real and problematic even though the CLEAR program is beneficial and logical for the long-term viability of the organization. The identification of influential knowledge champions and respected subject matter experts will be crucial to ensure success. The link between the CLEAR program and NCDOT goals must be made crystal clear to employees. Likewise, appropriate levels of compensation will need to be developed. Processes and communications must be transparent to all employees.
5. In order to maximize the probability of programmatic success, the CLEAR initiative must be presented to employees as a tool to solve the NCDOT's pressing challenges. It must be employee- and stakeholder-centric in nature such that the eventual form that the platform takes fits as seamlessly as possible with current forms of cross-employee engagement and knowledge sharing. The platform must be customizable to the greatest extent possible such that different divisions are able to make appropriate adaptations. CLEAR cannot be a one-size-fits-all approach.
6. KM initiatives are long-term propositions and require a commitment of extended support – both financial and human. Organizational gains will come slowly at first, but will build rapidly over time. Through enhanced knowledge collection efforts and improved communication channels, individual employee knowledge gains will grow and further develop organization-wide learning and the overall knowledge stock. The result will be an organization that transforms from a reactive to a predictive posture.
7. The NCDOT will need to identify, by division, what information/knowledge (i.e., "knowledge objects") needs to be collected and categorized. For organizations that are new to KM initiatives, a simple classification framework into *must-have* knowledge and *nice-to-have* knowledge works well initially. The must-have objects can be fine-tuned incrementally over time as the program evolves. This accomplishes two things. First, it enables employees to quickly grasp which types of knowledge are relatively more important. Second, the simpler the knowledge task, the less the cultural resistance.
8. In non-profit (NFP) organizations, KM capabilities are shown to benefit from an "elementary" initial approach that is scalable and evolves over time rather than when a radical change is instituted. Further, the organizational size, employee diversity, operational breadth, and geographic spread of the NCDOT necessitates that the CLEAR program would likely benefit from a controlled pilot rollout of the initiative (i.e., "beta" launch) versus an organization-wide rollout. One to three divisions should be selected for pilot rollout on the basis of identifying which divisions are either a microcosm of other, larger divisions or represent unique perspectives that will help proactively shape a full organization rollout.

NCHRP 20-108 identifies maintenance, construction, traffic operations, and public involvement as likely division candidates.

9. NCDOT employees will only participate in the CLEAR program initiative when the effort is valuable enough to justify the time of both those who input knowledge into the platform and those that withdraw it. Thus, a brokering model must be created whereby the system is designed to connect people, not simply collect information.
10. Internal marketing (IM) efforts should be largely focused on socialization strategies such as workshops, training, and information sessions rather than traditional communication vehicles such as mailings, intranets, and newsletters. A two-pronged approach to IM is recommended with traditional marketing used to generate organizational awareness and socialization strategies used to induce appropriate behavioral change. The identification of subject matter experts and influential individuals is essential in this effort. These efforts should be leadership inspired, yet employee embraced.

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INTRODUCTION

In order for the CLEAR initiative (**C**ommunicate **L**essons, **E**xchange, **A**dvice, **R**ecord) to be effective over the long run, the organizational focus will need to be on several factors: (a) understanding the organizational culture and adapting CLEAR program facets to current modes of operation; (b) developing a training program for both NCDOT management and front-line personnel; (c) creating a multi-faceted communication platform focused on the various stakeholders (internal and external); and (d) developing a program governance structure that can persist in an atmosphere of funding uncertainty and employee turnover.

This research initiative resulted in five (5) deliverable reports to the P.E., Clare Fullerton. These reports (as noted below) go into much greater detail than this current report and should be consulted by any reader desiring more detailed information regarding academic and managerial conclusions drawn from this research project as well as more specific recommendations for action by the NCDOT. The individual research deliverable reports are:

1. Scholastic research report on Knowledge Management Program Best Practices (March 2020)
2. Research report on USDOT and FHWA Peer Exchange partner DOTs (August 2020)
3. Research report on internal NCDOT personnel with regard to perceptions of cultural innovation (June 2020)
4. Research report on Lessons Learned from the CLEAR program launch (September 2020)
5. Research report on a Communication Plan for the CLEAR program launch (November 2020)

RESULT OF LITERATURE REVIEW

All literature sourced for the development of this research project are cited within the report text as footnotes. A full bibliography citation for each footnote can be found at the end of this report. The personal business experience of the author in both KM and related enterprise-wide initiatives was also used to provide insights into this investigation. These insights are not explicitly footnoted in the text but are presented directly in the report text.

REPORT BODY

1. Knowledge Management Initiatives

Capturing and managing the collective intellectual capital of organizations is a dominant theme across a diverse range of companies and organizations. It has been a priority of the USDOT and

FHWA for several years[1]. Numerous organizations have launched knowledge management (KM) initiatives over the past 20 years – with mixed results[2]. Knowledge management typically refers to an organization's investment to improve the internal exchange of proprietary information via dialogue or codified content. While knowledge is commonly acknowledged to be a source of competitive advantage, the fact remains that most of an organization's crucial knowledge resides with individuals, not the organization.

Individual learning does not often translate into organizational learning[3]. When individuals leave an organization, their repository of knowledge leaves with them. Most knowledge transfer in organizations is limited to face-to-face interactions between individuals. Likewise, discoveries and best practices from one part of an organization rarely, if ever, get shared with other parts of the organization due to cultural or organizational barriers. This lack of knowledge sharing often leads to lost productivity, individual frustration, and operational inefficiencies.

While individual knowledge can be highly valuable, it is self-contained and difficult to both extract and disseminate. Knowledge sharing is difficult even in small organizations and the problem of KM is magnified when the number of divisions is in the teens and the number of employees is in the hundreds or thousands[4]. Yet, while the task of capturing diffuse knowledge is difficult, the power of such large-scale knowledge sharing greatly overshadows what individuals or small teams can accomplish on their own[5]. Hence, the CLEAR program is a welcome attempt to advance the NCDOT on an organizational level.

Most organizations recognize the need for KM initiatives, but these are often delegated to the IT departments (or, at times, HR) without tying it to an overall corporate or organizational strategy. Leading a KM initiative with IT is a common recipe for failure[6]. The problem with many of these initiatives is that the organization merely creates an inventory of individual knowledge without parsing out the knowledge that is strategically relevant. A *strategic* management of organizational knowledge entails focusing on those knowledge assets that are critical to the organization's competitive performance.

Organizations that have created effective and efficient KM initiatives typically embrace three broad concepts[7]. First, they have a dedication to *knowledge gathering* and are committed at all levels of the organization to the collection of objective data. Top management teams are overtly supportive of the collection initiative. Second, they make a clear commitment to *knowledge*

[1] cf. NCHRP Research Report 885 (2018).
[2] cf. Bryan (2004), Choi & Chandler (2020), Chong & Choi (2005), Davenport (1998), Gilmore (2003), Lang (2001), Spender (1996).
[3] Cohen & Levinthal (1990), Dixon (2000), Henard & McFadyen (2006; 2008), Jaworski & Kohli (1993), Rossi, et al. (2015).
[4] Hume, et al. (2012a; 2012b), Lettieri, et al. (2004).
[5] Adler (2020), Ballantine (2000), Burk (1999), Colyar & Jodoin, Malhotra, et al. (2017), Valentine (2018).
[6] Donahue (2001), Chang & Lin (2015), Goh (2002).
[7] Jaworski & Kohli (1993), Henard & McFadyen (2008), Peters (2000).

sharing. Organizational or cultural silos that inhibit this cross-organizational sharing are eliminated or modified in order to facilitate the transfer of knowledge. Third, they are driven to use the knowledge platform to make objective, *market-based decisions*. In essence, past lessons learned help to guide contemporary decisions. Over an extended time, advanced organizations use lessons learned from the knowledge platform to *predict* the probability of future events.

There are two broad emphases in scholastic KM research: the concept of *knowledge* and the concept of *knowing*[8]. The concept of knowledge is generally viewed in a couple of ways. One way is to view knowledge as being comprised of three main elements: declarative (know what), procedural (know how), and causal (know why) knowledge. Another way is to view it as a level of diffusion within a reference environment whereby knowledge is held by individuals, groups, larger organizations, and multiple organizations. The concept of knowing is viewed as an organic entity that is accumulated dynamically due to an incremental process whereby available information is synthesized with the memory of both the individual and the organization. The sharing of knowledge (which leads to knowing) is widely recognized as an intangible activity that resists attempts to constrain it by strict control mechanisms. This sharing cannot be coerced. Individual knowledge will only be shared on a voluntary basis.

Quantifiable organization-level performance improvements from extant KM initiatives have been modest at best. Simply capturing best practices or lessons learned has performance limitations. While there is value in communicating discrete practices from the past, the moment that you capture lessons learned and make them explicit knowledge capital, the value begins to decay. While having a lessons learned database is certainly preferable to the alternative, it is not a panacea. The database alone cannot be the extent of the platform. To ensure programmatic success, a KM initiative must be multi-faceted and multi-level. Knowledge must be differentiated from information. The crucial roles of management, technology, and culture must be harnessed. Likewise, program risks must be understood and mitigated. In the following pages, I explore each of these issues more fully.

2. Knowledge or Information

Creating an effective KM platform begins with making a distinction between knowledge and information. While these terms are often used interchangeably, they are quite different. *Information* is the input data that is used to inform a decision. *Knowledge* is what provides the context to how individual's think and approach a decision. In most organizations, knowledge typically has a much longer shelf life than information; yet even the most proprietary knowledge has an eventual half-life whereby it eventually becomes common knowledge. In most organizations, intangible knowledge is underutilized. Non-profit organizations, in particular, often underestimate the value of knowledge assets[9]. Effective KM initiatives must therefore

[8] Ihrig, et al. (2011), Im, et al. (2016).
[9] Hume & Hume (2016).

enable an organization to cultivate and share new ideas. The issues that most organizations face when launching a KM initiative are determining:

- How to differentiate information from knowledge
- How much of each type to collect and archive
- How to structure the exchange platform so that users can easily identify the two

In large or diverse organizations, a competitive advantage from knowledge management comes through the internal exchange of insights that help employees to think differently when they are making decisions or taking action. Knowledge exchange helps to minimize duplication of work activity and assists in learning for future activities and product or service improvements.

While transmitting explicit information is relatively straightforward and low in cost, accomplishing the exchange of knowledge is more difficult for organizations because people must be persuaded that the quality of the thoughts, the facts, and the logic presented to them by others is superior to what they already know. Motivating employees to use the knowledge of others can sometimes be just as difficult as motivating them to share their own knowledge.

Conversely, organizations must motivate employees to contribute valuable knowledge to the platform. By designing a strong platform for knowledge sharing and creating a culture that encourages individuals with distinctive knowledge to produce and share that content, organizations can effectively aggregate the multiple ad hoc, face-to-face knowledge management mechanisms that already exist into a larger repository that is available to the organization at large[10]. Some crucial questions, however, are to determine which insights are most relevant to collect, how much to collect, and from whom.

Employees will only participate in a KM initiative when the effort is valuable enough to justify the time of both those who input knowledge into the platform and those who withdraw it. As such, organizations need to create a marketplace atmosphere around the initiative. Common knowledge, much like information, does not require trading. To incentivize individuals to consume common knowledge, the platform needs to make sure that this knowledge is insightful and informational. It should also be easier to find, gain access to, and assimilate than by existing conventional means. If possible, the knowledge should be supported by an opportunity to interact with the author of the content. Most organizations fail at this task.

3. Types of Knowledge

Knowledge is typically categorized into *explicit* knowledge and *implicit (*or *tacit)* knowledge. Explicit knowledge answers the questions of 'what' and 'how,' whereas implicit knowledge answers the relatively more important question of 'why.' Explicit knowledge is akin to "information" that was discussed previously. This is easily codifiable material such as processes,

[10] Adler (2020), Burk (1999), Lorenz (2018), Rossi, et al. (2015), Salgado, et al. (2020), Wenger & Snyder (2000).

procedures, policies, and specifications. Explicit information can be easily transmitted across individuals via books, manuals, or databases. Capturing this type of knowledge is the dominant focus of most contemporary KM initiatives, yet it is arguably the least valuable of the two types. A substantial number of organizations continue to try to derive competitive advantage from their individual stock of explicit knowledge – most often to the detriment of the KM initiative.

Implicit knowledge is more difficult to ascertain. It is often referred to as "sticky" knowledge because it resides in the heads of employees, customers, and suppliers. It is difficult to quantify, yet far more valuable to organizations than explicit knowledge. The very nature of its stickiness also makes it difficult to capture and transmit to others. One of the central goals of KM is to make implicit knowledge more explicit, which serves to boost the overall organizational intelligence. In other words, organizations need to transform individual information/knowledge into organization-wide information/knowledge. Individual knowledge easily moves in and out of the organization (i.e., "knowledge leakage") because it "sticks" with a particular employee. Conversely, organization-wide knowledge is "social" in that it becomes collectively embedded in the company's routines, norms, and culture. Greater social knowledge helps to reduce organizational knowledge leakage even when individual employees are lost.

Organizational knowledge has arguably become a strategic factor of production in many organizations. As such, contemporary managers must focus on the production of knowledge in an organization at least as much as they do the production of labor or capital. The questions of how knowledge is produced, acquired, applied, and retained are important organizational concerns. Managers should view the organization as a *body of knowledge* that needs to be tapped and managed. Importantly, KM programs and platforms should not solely be top-down initiatives. Upper level managers are better served by providing an atmosphere where employees at every level of the organization become independent agents, take personal responsibility, experiment, and learn as they strive for continuous personal and organizational improvement.

While individual knowledge is routinely differentiated as being either explicit or implicit in nature, organizational knowledge is better viewed as the skilled process of leveraging resources to the point that knowledge is permanently embedded in the organization. Organizations can only collectively learn and freely share their knowledge experiences when employees' sense of self and identity is malleable and becomes influenced by the social identity of the organization. Individual employees need to be socialized into an organization such that they share in, and contribute to, the collective knowledge that underpins the organization as a whole. KM initiatives like the CLEAR program are crucial to this socialization.

4. The Role of Information Technology (IT)

It should be noted that IT systems play an important role in KM initiatives and without active IT involvement, many initiatives would be less effective and applications of knowledge less timely.

Yet, an optimal KM platform entails developing a human-technology hybrid solution[11]. Managers often have a difficult time disassociating the IT aspects of a KM initiative from the management of knowledge itself. The trick is to think of technology and data/document management as only one part of the larger organizational KM program. KM champions and top management need to be careful to support the current non-linear way that work gets accomplished in any organization. In essence, prior to a KM initiative, organizational knowledge is *socially constructed*. If the new system or platform does not accommodate the organization's current social aspects, the results will be underwhelming and employee adoption will suffer.

Technology should only be a portion of a larger KM system with an emphasis on connecting people, not collecting information. Leading a KM initiative with technology produces only modest gains at best. IT is typically overly focused on capturing explicit knowledge because that is what is easiest to accomplish. There is even some anecdotal evidence to support the assertion that an overreliance on a technically-driven database can lead to organizational inefficiencies. For more experienced employees, the time spent analyzing databases can prove somewhat wasteful in trying to solve a particular problem. For these employees, time seems to be better spent connecting with experienced others. That said, more junior or inexperienced employees seem to derive the most benefit from static databases; thus, IT systems for codified knowledge need to be established and maintained but their usage by individuals might vary according to career stage.

Most companies find it somewhat difficult to create an environment where individuals want to share what they know and learn with others. Technology helps organizations to offer instant access to large amounts of data and to foster cross-functional and long-distance collaboration. There is little doubt that technology is a necessary component of any KM program. It is, however, not a sufficient component. The critical task is to choose and implement a suitable IT platform that provides a fit between people. This is an organization-specific task, yet the technological barriers that IT can have on knowledge management initiatives are fairly generalized and include:

- Lack of integration of KM technology into existing, legacy technology systems
- Lack of technical support for problems uploading or accessing knowledge
- Unrealistic expectations of employee technological capabilities
- Lack of training on relevant KM system platforms
- Lack of communication on the advantages of the KM system platform

Thus, for any KM initiative, it is imperative that IT play both a technologically and organizationally appropriate role.

Perhaps the dominant complaint of IT systems is the lack of system availability in the field. Mobile access is often lacking as are convenience aspects such as photographic reporting of information. In non-profit (NFP) organizations, much of the captured knowledge is stored on

[11] Donahue (2001), Hume & Hume (2015), Ihrig, et al. (2011), March & Gavin (1997), Riege (2005).

local file servers and paper-based filing systems with no formal socialization strategies to create and document future knowledge or to amplify it across multiple groups or divisions. The IT aspects of KM systems in NFP organizations are often office-based (e.g., PCs, local servers, intranet), which leads to a frustration amongst employees when trying to utilize the system outside of the office. In fact, IT is often seen as the most frustrating element of the KM system. While IT is a key enabler to KM initiatives, it is not sufficient in isolation without effective support, continuous upgrading, and overall alignment with the general strategy. IT services must be planned, managed, and supported from the onset of a KM initiative.

The services literature – specifically service failure research – has some parallels that are important to consider in a KM context. Service failure interactions (i.e., leading to customer dissatisfaction) are often broken down into two aspects: (a) the *outcome* of the expected service fails, or (b) the *interaction* with the company or representative during the service fails. With (a), what the consumer expected to receive did not materialize (e.g., they were bumped from a flight). With (b), the interaction with the company/representative was less than satisfactory (e.g., the gate attendant was rude). Overwhelmingly, individuals are more upset when there is a failure with the interaction (i.e., process failure) than when there is a failure with the outcome. In a KM program, the IT platform interface represents the interaction point and failure on this level can have deep, negative implications with regard to employee motivation to participate in a knowledge sharing system. Thus, the design of the IT interface is crucial to the success of the CLEAR program.

5. Structural Approaches

To date, organizations have taken three broad approaches to launching KM initiatives and developing the associated platforms. One option is the *self-directed approach*. In this approach, the organization initially provides employees with a database of information. Most, if not all, of the database content is populated from corporate staff. The database can expand over time as employees are encouraged to add to it by contributing current insights and lessons learned from their specific activities. Individuals can hunt for information via a keyword search. This is a relatively low-cost option, which is why it is the dominant form of most KM initiatives. This low cost is its primary selling point. The downside of a self-directed approach includes: (a) if the search engine is not optimized to reflect appropriate key words or if the data is not arranged "properly," employees become discouraged and cease searching in the future, (b) employees are naturally more inclined to retrieve data than they are to contribute it, and (c) employees are reticent to input negative information.

A second option is the *knowledge network approach*. In this approach, networks of employees share best practices with peers. This is akin to storytelling and has strong anthropological underpinnings. Here, employees have regular meetings to discuss lessons learned. A knowledge database is also employed, as in the self-directed method, but it takes on a somewhat secondary role to the human interaction. Lessons learned via discussion (face-to-face or distance) are added

to the existing database. While still a relatively low-cost option, this approach complements the existing social relationships that are already at play in the organization. Cross-functional or cross-departmental knowledge is captured. New knowledge added to the database has the benefit of being vetted by multiple people as well as providing individual "cover" for the inclusion of any negative information. The downside to this approach is that it: (a) is slower to build stored knowledge than other approaches, (b) takes time away from primary job responsibilities for those involved, and (c) is subject to manipulation by those in higher level positions.

The third option is the *facilitated transfer approach*. This is a full-service approach to knowledge management. Here, specific employees are overtly designated as knowledge managers whose job it is to integrate best practices across the organization or their specific department/division. These people are responsible for directing those with specific questions or needs to those who possess the knowledge to satisfy those needs. This is typically someone who is has a lengthy tenure with an organization and/or someone who is well connected with members across the department or organization. Surprisingly, the most effective of these people are *not* individuals who are of high organizational rank. The benefits of this method are that it relies on the human element, which is typically the most preferred method of knowledge transfer in most organizations. The downside includes the enormous time that being a facilitator takes. This is why such individuals are often those who are facing retirement in a few years or have returned from retirement to act in a service capacity. Of course, the loss of these individuals (with no backup plan) produces the same knowledge loss that the KM initiative was created to avoid.

Often, KM programs are built upon what is termed a *publishing model*, whereby data is collected and stored, its availability is advertised to the organization, and managers sit back and wait to see what happens. Many of these efforts collapse because the knowledge catalogued is often primarily explicit knowledge that becomes obsolete almost as soon as it is generated. Next generation KM strategies place relatively greater emphasis on connecting individuals who have the requisite knowledge with those who need it (i.e., a *brokering model*) than they do in codifying tacit knowledge. Key personnel need to be explicitly noted (e.g., "yellow pages") and the relationships between people in a network need to be visible to the entire organization. Quite often, the individuals who are most connected and provide a so-called social glue for the organization are not those in positions of power or higher paid high salaries. They are often found on the periphery of an organizational network. Paradoxically, the more that some organizations let knowledge/information reside in employee's heads and use technology to connect people (rather than attempting collect it all), the more individuals choose to share their knowledge with others.

6. Non-profit Organization Implications

Non-profit organizations are under increasing pressure to adopt for-profit practices such as knowledge management. The vast majority of both scholastic and practical evidence on knowledge management centers on large, for-profit organizations. These insights provide us with

some common characteristics to examine – some of which are often absent or deficient in non-profit organizations. Relative to for-profit organizations, non-profit entities, such as government agencies, often suffer from a lack of professional staff focused on knowledge capture, mature process management systems, performance measurement systems, and proficiency in implementing organizational change initiatives[12]. Importantly, NFPs do not typically recognize the creation of profit for stakeholders as their primary mission. A shared profit motive is often credited with generating employee buy-in to KM initiatives.

In contrast to for-profit firms, non-profit organizations typical operate locally and specifically to their mission. The heterogeneity of the sector makes it difficult to define a generalized roadmap to excellence. NFPs typically have limited resources, financial constraints, strict protocols of decision-making governance, legislative oversight, and lack of funding for information technology solutions. They also suffer from a lack of focus on internal marketing programs designed to promote knowledge contribution, capture, and diffusion. Throughout rank and file NFP employees, there is commonly little understanding of the performance enhancing role that KM can play. There is also often a perception that knowledge is too unwieldy to manage and should not distract employees from focusing on their core daily activities.

NFPs can be complex due to a mix of part-time, full-time, and tenured employees that neither understands nor embraces the practice of knowledge capture and knowledge sharing. Likewise, external stakeholders (e.g., general public, legislators) can be complex. Non-profit organizations often tend to have rigid governance structures and institutionalized organizational silos. Regardless of organization type, all KM initiatives require strong leadership and widespread organizational support to succeed. These are often in relatively short supply in NFP organizations. Changing government policies, political positioning, and shifting organizational structures each contribute to the unique difficulties that non-profit organizations face, relative to their for-profit peers. Geographic coverage also creates challenges for communication management and dissemination of knowledge in NFPs. It should be noted that NFP organization size does not directly translate into the KM initiative's organizational capabilities. The most successful NFP organizations are those more strongly correlated with a broad understanding of KM principles than with size.

Even as more and more NFPs seek to adopt stakeholder-oriented governance models based on inclusiveness and broad employee participation, KM initiatives are often viewed as a *strategic* activity (i.e., the responsibility of upper management) that is very complex and expensive. When employees are unsure of basic KM concepts, they tend to view the initiative as residing in the domain of upper management and not something that they are directly responsible for. The desire to "act locally" is also strong in geographically dispersed NFP organizations. Within NFP organizations, knowledge is generated and flows across four increasingly broader levels: from

[12] Hume, et al. (2012a), Hume & Hume (2016), Lettieri, et al. (2004), Rossi, et al. (2015), Swanson (2013), Taylor & Taylor (2013).

the individual level to the group level, then to the organization level, and finally to the community at large. NFP case study analyses indicate, however, that there is a strong tendency for employees to maintain knowledge at an individual level even when that knowledge could be codified and shared across the organization. To facilitate a flow of information, it is important for organizations to take care of existing social relationships when developing a KM program.

Capturing and managing knowledge as well as the subsequent filtering and codification of information is a common challenge for NFP employees. Too often, there is a misalignment in structures, support, and strategy across the organization. Whereas the motivation for KM in for-profit organizations is typically widely understood and shared, the same does not hold for NFPs. NFP employee adoption of KM practices is largely limited in scope, informal in nature, and rarely viewed as a priority investment that is operationally supportive. When current organizational knowledge is predominantly captured and shared in an informal or unintentional manner, it becomes highly important for managers to communicate why a change in knowledge management capture (i.e., CLEAR) is worthwhile to the organization.

Knowledge sharing in NFPs is often met with both passive and active resistance[13]. If the employee population is relatively transient, the need to present KM as non-threatening and personally beneficial increases. Building trust with the organization's stakeholders takes longer than with for-profit counterparts. Subject matter experts and their associates need to be "socialized" within their own divisions to share knowledge and lessons learned. Over time, communities of practice that span multiple divisions can be useful in promoting a KM culture. Creating forums, events, and other activities that foster engagement and discourse is paramount to developing trust across an NFP organization. Performance measurement can be exacerbated by numerous stakeholders across multiple, often diverse, divisions or groups. This fact lends support to the view that any performance measurement system for a KM initiative must be based on a stakeholder perspective with a measurement of both process delivery and outcomes.

7. Practical Considerations

Best practices in knowledge management initiatives[14] often come down to four basic and practical steps:

1. Create a setting for sharing knowledge
2. Reduce or eliminate communication filters
3. Prioritize tasks for individuals
4. Keep a time budget

Step number one deals with both organizational structure and top management support. Since knowledge is perhaps the only resource that actually grows when it is shared with others, it is vital to create an organizational environment where everyone is encouraged to share and is

[13] Lin, et al. (2011), Riege (2005).
[14] cf. Bryan (2004), Choi & Chandler (2020), Chong & Choi (2005), Davenport (1998), Gilmore (2003), Lang (2001), Spender (1996).

invited to participate. Thus, meetings should be open-door and transparent. Platform tools (e.g., SharePoint, Notes, workshops, etc.) should be accessible to all employees. Organizational silos and cross-functional politics typically interfere with information sharing and tend to reduce the effectiveness of any KM initiative. When it comes to knowledge sharing, the platform developed needs to allow individuals to cross departments, skip organizational levels, and provide anonymity where appropriate.

Prioritizing tasks helps to align organizational effort behind those aspects of KM that are strategic and truly important to the organization as a whole. Senior management needs to assess and prioritize tasks for the organization – clearly and without obfuscation. Of course, prior consultation with key individuals who will implement the initiative should be used to shape strategy and tactics. The final step takes place in either a pilot or full rollout of the program. That is to measure how much time individuals are spending on KM activities and which activities they are focused on. Everyone should be encouraged to allocate a specific amount of time each week, for example, on KM. However, early assessments of time management can identify areas of inefficiency as well as help to prioritize future activities. What is asked of employees must work within the specific organizational context such that it is subject to resource availability and the strategic orientation of the organization.

The most valuable insights from a KM initiative are accomplished relatively slowly. Capturing knowledge is not a straightforward, technological issue such as finding the right configuration of databases or platforms. It is first and foremost a *human capital issue* that requires distinctive tools and understanding. Often, such initiatives produce more questions than answers, which calls for an overall strategy that favors flexibility. Since knowledge itself is not static, the platform for sharing it should be designed to be flexible and adaptable. Understanding how your organization works and how it is likely to evolve in the future is critical to developing an initial KM strategy. Organizational culture cannot be changed overnight and forcing employees to adopt a KM platform that is dramatically different than their current methods of knowledge sharing is likely to result in initiative failure. Thus, it is important to ensure that employees can continue to use their preferred mode of knowledge sharing even while the migration to a new platform is underway.

8. Knowledge Sharing

Knowledge can be shared in a variety of ways. Prior to commencing a KM initiative, it is imperative to understand which types of knowledge and what levels of knowledge sharing are relevant to the organization. These insights help to shape the short-term and long-term objectives of the organization. Scholars have classified five general levels of knowledge sharing[15]:

[15] e.g., Burk (1999), Bryan (2004), Chong & Choi (2005), Dixon (2000), Donahue (2001), Henard & McFadyen (2006), Im, et al. (2016).

1. *Serial knowledge transfer*. This is where explicit knowledge is shared among employees in a similar environment (e.g., same team, division, etc.) to either solve an issue in a current setting or to transfer explicit knowledge from a previous encounter to a similar one in a different setting. This type of knowledge is storable and retrievable from personal records or memory (i.e., codified).
2. *Near knowledge transfer*. This is where explicit knowledge from personnel in one division or team is replicated in other similar situations encountered by the same division or team. This type of knowledge benefits situations where a group of individuals faces task/solution similarities across various intra-group work settings.
3. *Far knowledge transfer*. This is where implicit knowledge from personnel in one division or team is used to guide personnel in other situations or settings across different divisions or teams. This type of knowledge also takes advantage of the fact that similar situations might be encountered by different groups within the same organization, albeit in a different group or team.
4. *Organizational know-how*. This is knowledge (explicit and implicit) that is needed to complete a task that individuals encounter on an infrequent or rare basis. This knowledge represents all the knowledge embedded in an organization's social and institutional practices, systems, and culture. Even knowing which questions to ask or with whom to consult with are difficult tasks and often require a collective effort.
5. *Expert knowledge transfer*. This is knowledge that requires an expert in a field – either internal or external to the organization – to complete a task. The information needed to successfully traverse the situation can only be obtained from a select few number of individuals. This knowledge is not easily stored or codified.

9. Organizational Learning Implications

Organizational learning has been studied for about three decades. At its core is the concept of "absorptive capacity" – both at an individual and organizational level[16]. Absorptive capacity is simply the belief that individuals and organizations must have a sufficient stored amount of prior, or existing, knowledge in order to recognize and assimilate relevant new knowledge. Knowledge is often viewed from two broad perspectives: *depth* and *breadth*. A depth of knowledge is developed over time as one learns information and develops skills. As this information is shared across individuals, the organization-wide depth of knowledge also increases. A breadth of knowledge occurs by incorporating information from sources that are external to the individual. These sources can take multiple forms and can arise from both inside and outside the organization. The ability to exploit external knowledge is a crucial component of innovative capabilities, yet without a depth of knowledge, it is difficult to recognize new knowledge that might be applicable to a current problem.

Boosting both the depth and breadth of employee knowledge is important on a host of levels[17]. Since learning is cumulative, learning performance is at its greatest when the object of learning is

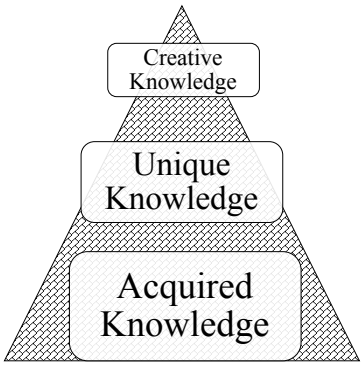
[16] Cohen & Levinthal (1990), Jaworski & Kohli (1993).
[17] Henard & McFadyen (2006; 2008).

related to what is already known. Individual problem-solving capabilities increase with experience and training. Likewise, experiences in one setting can influence and improve performance in another setting. Organizational learning is not simply the sum of individual employee knowledge levels, but they are related and KM initiatives such as CLEAR are often the bridge that connects the two. Following, I discuss these two aspects of learning.

10. Individual Knowledge Levels

Employee knowledge is arguably the principal intangible resource that organizations possess. This knowledge is largely idiosyncratic and takes time to develop. Researchers categorize individual knowledge into three hierarchical levels[18], which are depicted in the following diagram. *Acquired knowledge* is the base knowledge resource that an individual offers an organization. This level of knowledge is available to others and is often shared within and across teams or divisions. It is necessary, but not sufficient, in order to operate at higher levels of knowledge. Because this level of knowledge is the base for higher levels of learning, it is key to boost this level of knowledge across as many individuals as possible.

Unique knowledge requires a higher level of cognitive processing. Here, individuals have the ability to use their acquired knowledge to recognize, obtain, and integrate new knowledge from other sources. Moving to this level of knowledge dramatically increases an individual's absorptive capabilities and they begin to think beyond narrow, functional silos. *Creative knowledge* represents the highest level of knowledge activity. Here, individuals capitalize on their acquired and unique knowledge and become alert to possibilities that can lead to breakthrough ideas. Creative knowledge capabilities go beyond making connections between two or more sources of information to actually creating new ideas from those connections (i.e., innovation). Individuals who attain this level are extremely powerful resources and their efforts work to boost the capabilities of other employees.



[18] Ibid.

The key question for managers is how to develop the cognitive capabilities of individual employees because this is the foundation for organization-wide capabilities. There are five steps to help organize for this knowledge development:

1. *Adopt a capability mindset*. Managers must embrace individual employee knowledge as a crucial organizational facet. Knowledge enhancing activities must be openly valued and acknowledged, while failure to participate in knowledge sharing must be discouraged and, in some instances, punished.
2. *Promote cross-pollination*. Where feasible, managers should consider rotating individuals to various responsibilities over time. Rotating employees across teams or to new responsibilities within a current team is a good way to promote unique cognitive capabilities.
3. *Reduce barriers to growth.* In order to move up the knowledge pyramid, individuals must have the freedom to interact with others within and outside of their teams or divisions. Managers need to break down functional and hierarchical silos that interfere with this.
4. *Reward knowledge sharing activity.* Employees will act in a manner that is consistent with their compensation/reward structure. Sharing knowledge and moving up the pyramid entails engaging in activities beyond current roles. Managers must reward these efforts.
5. *Don't forget the bottom line.* Sometimes, overzealous employees devote so much time to knowledge sharing activities that their core job function can suffer. While KM should be encouraged, managers must remain mindful that there is still a fundamental job that needs to be accomplished.

11. Organizational Knowledge Levels

Organizational learning involves balancing the generation, development, and acquisition of new knowledge (i.e., *exploration*) with integrating, disseminating, and applying that newfound knowledge (i.e., *exploitation*)[19]. It is sometimes viewed as the process of improving work practices. An organization's absorptive capacity depends upon the absorptive capacity of its individual members and its success or failure rests heavily on how well (or poorly) knowledge is communicated within and across divisions. Assuming sufficient levels of knowledge overlap from these exchanges, an organization's capacity for both recognizing new/unique knowledge and making novel/new associations far exceeds that of what any single individual could accomplish.

If an organization does not develop its individual and organizational absorptive capacity, it is likely to suffer what scholars refer to as "lockout." When there is an insufficient depth and breadth of knowledge within an organization, individuals begin to look inwardly at past solutions for answers to current problems. Employee beliefs and viewpoints tend not to change because the organization as a whole might not be aware of marketplace signals and opportunities that would otherwise alter its view on any given situation. When new opportunities arise, these organizations might not recognize or appreciate them.

[19] cf. Cohen & Levinthal (1990).

Organizations with higher levels of absorptive capacity tend to be more proactive, be less parochial, and exploit opportunities that present themselves. Those with relatively lower levels tend to be reactive and overly focused on responding to current failures or crises. Interestingly, if organizations do not develop these capabilities relatively early on, the not invented here (NIH) syndrome seals in this lockout effect as new ideas, practices, technologies, etc. might be too distant from the organization's existing knowledge base to be appreciated. In sum, KM-oriented organizations need to have a dual focus. Efforts to boost individual knowledge levels should be coupled with a platform that promotes communication and engagement. This is how overall organizational learning occurs and matures over time.

12. Organizational Culture Implications

As research on KM has matured, efforts have increasingly shifted from a technological focus of inputs and outputs to an emphasis on altering the nature of organizations to facilitate knowledge flow. The NCHRP notes that having a culture of innovation in DOT organizations that accepts and encourages innovation is an important contributor to agency success[20]. Such a culture enables the speed of knowledge sharing and adoption and leads to enhanced performance. In knowledge sharing initiatives however, the efforts by individuals often clash with organizational culture. In fact, organizational culture is uniformly noted as the greatest barrier to widespread KM adoption. Far more KM program failures are attributable to cultural factors than to technology barriers.

KM typically requires a major shift in organizational culture as well as a commitment at all levels to make it work. Yet, culture runs deep and employees are often unaware of the underlying assumptions and mechanics of their culture until they encounter initiatives to change that culture. While shaping culture is paramount to developing a successful KM program, top managers often make organizational assumptions (with regard to change initiatives) that fail to materialize. Among the culture assumptions NCDOT managers should avoid are:

- *Assuming that individuals will naturally adapt to the new changes in how business is conducted*. Outside of a few narrow exceptions, most individuals are resistant to change. Employees need to be convincingly motivated by incentives (or fear) to adopt changes.
- *Individuals will function rationally.* The belief is that when presented with a logical argument for why the new initiative is necessary or beneficial that employees will "fall in line." This is often a fallacy and flows from the previous assumption. Even if something new is in the best interest of an individual, it often takes more convincing than planned.
- *Organizational change will occur automatically.* The assumption here is that once a direction is dictated by someone in authority that everyone will adhere to the changes. Without overt and persistent support, sufficient resources, and individual incentives, the wheels of change will move slowly and can often be resisted.
- *Organizational culture is easy to change.* As noted previously, most people are resistant to change initiatives. They must be incentivized (positively or negatively) to change. Changing

[20] Lorenz, et al. (2018).

a culture is the most difficult part of any major strategic initiative, which is why it is important to design new programs in a fashion that works within (as closely as possible) current social networks and organizational practices.

Knowledge transfer requires the willingness of individuals to work with colleagues and share knowledge to their mutual benefit. As such, knowledge transfer is unlikely to occur in organizations whose existing culture does not promote sharing. Employees must have some level of cooperative behavior in order for a KM initiative to have chances of success. Without a natural extant tendency to share or collaborate, creating such a culture from scratch is nearly impossible. Trust between individuals and in the organization is also a critical existing component to developing a knowledge sharing culture. Without a fundamental level of organizational trust, mechanisms to encourage collaboration will not work.

The organizational hierarchy in place has a pronounced impact on culture. Regardless of whether the established hierarchy is structurally defined (i.e., org chart) or socially defined (i.e., sub-unit value determinations), it is very often detrimental to the cause of learning and innovation. Those either in the out-group or lower in the hierarchy are often too intimidated to engage in the critical cognitive behaviors that are essential to KM. Biases across divisions – resulting from funding disparities, organizational castes, etc. – can also create barriers to organization-wide adoption of KM initiatives. At times, personality barriers are created between specific individuals within the organization that impedes adoption.

Dictatorial, top-down approaches to securing KM adoption are also often resisted, especially in geographically dispersed NFP organizations. When considering cultural change initiatives, it is crucial to identify the key aspects of the current social architecture (i.e., the collective ways employees work together to accomplish tasks). In many NFP organizations, these are often informal. When there is formality in processes, it is often largely imposed by individuals who are either directly responsible for the associated action or by employees with greater relative tenure in the organization.

13. Risk Factors

Too often, organizations undertake firm-wide initiatives because the focus is solely on the perceived positive outcomes. While this is understandable, it is only one side of the equation when it comes to launching a strategic program. The flip-side of the calculation is to assess potential risks that pose a threat to programmatic success. In the realm of knowledge management initiatives, there are several risk factors to be aware of[21]:

- *Implementing a KM system prior to developing a customer-centric and/or employee-centric strategy*. Prior to the launch of a KM initiative, it is important to develop a comprehensive

[21] cf. Chong & Choi (2005), Davenport (1998), Gilmore (2003), Hume & Hume (2015), Ihrig, et al. (2011), Riege (2005).

understanding of both whom the program is designed to help as well as the individuals that are going to implement it. Developing a strategic program without a thorough understanding of all its component parts is a recipe for failure. Organizations must adjust their knowledge sharing goals and systems to the organizational culture, not vice versa.

- *Lack of a business purpose*. Too often, organizations develop a KM program in anticipation of a future payoff or because other similar organizations have implemented one. This is simply a solution in search of a problem that almost always results in program failure. The goal must be to take the organization's most pressing challenges and use KM to help solve them.
- *Failure to adequately and clearly define the end goals of the KM initiative*. One of the key reasons for failure of KM initiatives (notably in small and NFP organizations) is due to a lack of a clear connections between the KM strategy and the organizational goals. In organizations where work is heavily focused on overcoming immediate and pressing issues (e.g., NCDOT), individuals often view knowledge sharing as an activity that is *separate* from their daily responsibilities. The relationship between knowledge sharing and both individual and organizational goals must be made explicit to employees.
- *Lack of top management support*. Time and again, failed KM programs cite the lack of overt top management team support of the initiative as a key source of failure. This support must persist beyond the euphoric kickoff or pilot phase of the initiative and be evident (in both word and deed) throughout the evolution of the program. If employees sense lagging support from upper management, they will cease to support the initiative themselves.
- *Lack of organizational resources*. There are multiple aspects to this risk factor. Of course, financial resources need to be allocated to the program. This includes not only money for a pilot launch but also for a full organizational launch in the future. There needs to be a clear financial analysis of the necessary investments over a longer timeframe. Human resource allocations need to also be adequately assessed. People are promoted and leave over time; so, the longer-term human factors need to be assessed and planned for.
- *Lack of customization*. KM programs are not one-size-fits-all. The program should be tailored to the individual needs of an organization. The program and its associated platforms must conform to the organization's culture and social network of individuals and activities.
- *Lack of accountability*. In order for a KM program to be successful, someone (explicitly) must be responsible for the success of the initiative. Without overt responsibility resting in one more individuals, most initiatives fail over time. The larger the organization, the more people that are likely required. While success is dependent on everyone in the organization participating, without overt responsibility (e.g., written into performance evaluations) residing in the appropriate individuals, initiatives are often left to slowly wane.
- *Political risk*. Senior leaders who are appointed by politicians might perceive personal positional risk from overt support of programs that might be viewed as uncertain.

14. Internal Marketing & Communication

Internal marketing and communication (IMC) efforts have been shown to be a key enabler of KM programs and are essential to the success of KM implementation in non-profit (NFP)

organizations[22]. In the CLEAR context, IMC is loosely defined as a planned effort using a marketing-like approach directed at motivating employees to implement and integrate organizational strategies. IMC can create a series of motivating activities that helps to drive knowledge from individual implicit levels to organization-wide explicit levels on an ongoing basis. Yet, IMC efforts at NFP organizations are somewhat different than at for-profit counterparts[23].

Traditional vehicles such as newsletters, promotional items, intranets, and recordings are shown to have *limited benefit* in driving NFP organization-wide behavioral change. While these vehicles have clearly been demonstrated to increase awareness of KM initiatives, the functional behavioral benefits from them are decidedly mixed to somewhat negative. Traditional communication vehicles used to drive awareness of the CLEAR program are necessary, but not sufficient. Such efforts have been shown to boost awareness of KM programs at NFP organizations. For example, employees have been shown to be aware of the operational, customer, and personal benefits of a KM program, yet they still failed to actively participate in the program for some of the reasons discussed in this report (e.g., not my job, not enough time, too complex). Thus, it is posited that a traditional-only IMC approach at the NCDOT will inform employees but will not motivate them.

Where NFP organizations have seen success in motivating behavioral change in KM initiatives has been in using socialization strategies. One approach in this vein begins with identifying individuals and groups within the organization within whom core process information and knowledge resided and establishing formal communication lines to those individuals. The second approach (at times, in tandem with the first) is to communicate KM program information via informal lunchtime presentations, workshops, training sessions, internal subject matter expert directories, and a Q&A Help Desk. It is also worth noting that a structural approach (i.e., agendas, regular meetings, selected venues) to these socialization strategies is beneficial. This approach appears to be the most effective, although relatively more time-consuming and difficult than traditional communication vehicles.

Thus, a dual IMC approach is probably warranted at the NCDOT. Traditional vehicles can be used to build awareness of the CLEAR program. A "teaser" campaign via traditional communication channels might be appropriate in the early, pilot phase of the rollout to pique employee interest and "brand" the program. Likewise, the identification of knowledge champions and subject matter experts to be used in an appropriate socialization strategy is also essential. Any communications transmitted via audio or video should highlight these individuals. The specific socialization tactics employed should be tailored to the culture of specific NCDOT divisions. To be useful, engagement activities need to be established and continuously managed through a strategic engagement plan in order to facilitate organization-wide collaboration.

[22] Hume & Hume (2015; 2016).
[23] *Although scholastic research on the topic is new and limited.*

15. Peer Exchange Overview

On June 1-2, 2020 the Federal Highway Administration (FHWA), sponsored by the Utah DOT (UDOT), conducted a virtual peer exchange meeting whereby representatives from 10 state DOTs met on-line to discuss the topic of innovation. State representatives included individuals from California, Colorado, Florida, Idaho, Iowa, New Jersey, North Carolina, Pennsylvania, Utah, and Washington. The purpose of the meeting was for participants to share practices on how to engage employees in innovation initiatives as well as discuss tools used to support a culture of innovation. Below, are some of the overarching themes that emerged as they relate to the CLEAR program.

Dashboards. A few states reported using dashboards in their innovation programs. While no concrete specifics were provided, those states employing them spoke about them as non-static information that was available for all employees to view. Information on the dashboards discussed appeared to be simple in nature (e.g., # ideas generated, $$ saved, etc.). A STIC scoring card was also mentioned. These dashboards were also mentioned as being used to influence upper management and legislators. One state mentioned that their dashboard was available for public viewing.

Storytelling. A couple of states reported the use of storytelling as a mode of employee communication. The foundational idea is that individuals will respond to, and remember more vividly, information that comes in a "story" mode (v. data-driven arguments). This is an anthropological approach that works well in small groups. NASA adopted this approach several years ago.

Engagement Events. Several states described efforts to involve and energize employees in their innovation initiatives. Some of the efforts noted include:

- Employee-voting on viability of ideas (e.g., internal polling)
- Shark Tank-like events to pitch innovation ideas
- Videos of innovation success stories
- Idea Link button for employees on DOT webpage
- EDC Summit (funded by STIC, Tech Transfer-T2)
- Annual research symposium
- Innovation Challenges (CA held five in 2019)
- Bi-monthly Webinar Wednesdays
- On-site interactions to generate ideas (local visits by a champion)

Awards. Reward structures varied. One participant noted that it was important to differentiate "good ideas" from "innovations." Some of the examples noted included:

- Ideas that led to STIC funding
- Build a Better Mousetrap award
- DOT clothing/gear
- Camping gear
- Private sector sponsors (e.g., State Farm – NJ)

ROI. Given the meeting structure and time constraints, the conversation on return-on-investment as relatively limited. Yet, perhaps the key comment (from Idaho) was to focus your metric on "the intent" of the innovation. Namely, *dollars* saved, *time* saved, or safety / injury prevention. Be wary to try and blend the two or to conduct savings assessments that extend beyond three years (i.e., the calculated point at which an innovation becomes standard operating procedure).

Miscellaneous. Some miscellaneous comments in addition to the above:

- Track ideas/innovations by department but track ROI by organization
- You must institute a formalized "process" to achieve success
- Innovation champions must attend training sessions
- Develop a formal scoring card with which to evaluate submissions
- Submissions can be submitted 24/7, but are only evaluated 3x per year
- Annual Organizational Climate Survey for leadership/upper management
- Tailor communication vehicles to specific audiences
- DOT employees are reluctant to share ideas
- All idea/innovation submissions must be followed-up to reinforce behavioral change
- Programs must be engrained into the organizational processes
- Must communicate that there are "no bad ideas"
- Iowa does not involve upper management in STIC review process
- Change Management training being incorporated in some states
- Roles must be overtly defined for individuals and teams leading innovation initiatives

16. Innovation Culture Index

The Innovation Culture Index[24] (ICI) was developed by the author to provide the NCDOT with a mechanism for an annual evaluation of the impact that the CLEAR knowledge management program has on employee perceptions of the culture of innovation at the NCDOT. It is currently being administered to each unit or division employee as part of the pilot rollout program. To date, nearly 300 NCDOT employees have taken the survey.

This 22-question quantitative and qualitative survey was designed to succinctly capture both the key aspects of the previously administered USDOT Innovation survey as well as the best practices of knowledge management programs around the world. A score of "4.0" or above on the ICI indicates a "strong" or "very strong" level of agreement with each statement. Scores in the "3.0-3.9" range indicate a "moderate" level of agreement with each statement, whereas scores of less than "3.0" indicate relatively strong disagreement with each statement.

A table denoting the mean ratings per ICI item across all respondents-to-date follows. Readers should bear in mind that these results are only representative of the perceptions of those

[24] Please see Appendix A for survey items.

employees who have currently completed the survey. Overall results can change as more units and divisions are rolled out over the next several months.

ICI Survey Question	Mean Rating
The topic of innovation is regularly discussed at our division/unit staff meetings.	3.4
My division/unit actively encourages employees to submit innovative ideas on a regular basis.	3.5
I feel comfortable offering my ideas on innovative improvements to my peers.	4.2
I feel comfortable offering my ideas on innovative improvements to my managers.	4.1
Successful innovative ideas are rewarded in my division/unit.	3.0
Successful innovative ideas are openly shared across my division/unit.	3.4
My division/unit has a formal process for submitting innovative ideas.	2.3
If I submit an innovative idea, I clearly know how that idea will be evaluated by others.	2.7
I am encouraged to spend work time thinking about innovative ways to improve my division/unit.	3.0
It is clear to me why innovation and knowledge sharing is important to the NCDOT.	4.1
My division/unit shares innovative ideas from other divisions that might be helpful to us.	3.2
NCDOT executive level managers actively support and promote innovation.	3.4
My division/unit level managers actively support and promote innovation.	3.7
If I have an innovative idea, I clearly know whom to tell it to.	3.4
My division/unit has a designated "innovation champion" who leads our innovation efforts.	2.2
Several people in the NCDOT act as "innovation champions."	2.6

17. Internal Marketing & Communication

Internal marketing and communication (IMC) efforts are a crucial enabler of knowledge management (KM) programs and are essential to the success of KM implementation in non-profit (NFP) organizations[25]. In the CLEAR program context, IMC is defined as a planned communication effort using a marketing-like approach directed at motivating employees to implement and integrate organizational strategies. IMC can create a series of motivating

[25] Hume & Hume (2015).

activities that helps to drive knowledge from an individual employee's implicit level to organization-wide explicit level on an ongoing basis.

As noted in previous reports, traditional communication vehicles such as newsletters, intranets, and bulletins have limited effect in driving organization-wide behavioral change. While these vehicles have clearly been demonstrated to increase awareness of KM initiatives, the functional behavioral benefits from them are decidedly mixed to somewhat negative at NFP organizations. Traditional communication vehicles used to drive awareness of the CLEAR program are necessary, but not sufficient. When communicated to via traditional-only mediums, employees have been shown to be aware of the operational, customer, and personal benefits of a KM program, yet they still failed to actively participate in the program for some of the reasons discussed in previous reports (e.g., not my job, not enough time). It is believed that a traditional-only IMC approach at the NCDOT will *inform* employees but will not *motivate* them to act.

Where NFP organizations have seen success in motivating behavioral change in KM initiatives has been in using *socialization strategies*. As previously noted, this begins with identifying individuals and groups within the organization within whom core process information and knowledge resided and establishing formal communication lines to those individuals. These individuals can then operate as advocates for the CLEAR program. An additional approach is to communicate program information via informal presentations, workshops, training sessions, internal subject matter expert directories, and a Q&A Help Desk. A structured approach (i.e., job-specific training, regular meetings, updates) to both of these socialization strategies is necessary.

A dual IMC approach is warranted at the NCDOT. Traditional vehicles should be used to build awareness of the CLEAR program. A "teaser" campaign via traditional communication channels might be appropriate in the early, pilot phase of the rollout to pique employee interest in the program. Likewise, the identification of knowledge champions and subject matter experts to be used in an appropriate socialization strategy is also essential. Any communications transmitted via audio or video should highlight these individuals. The specific socialization tactics employed should be tailored to the culture of specific NCDOT divisions. To be useful, engagement activities need to be established and continuously managed through a strategic engagement plan in order to facilitate organization-wide collaboration. This approach is detailed in the Deliverable #5 report.

FINDINGS and CONCLUSIONS

With regard to best practices and lessons learned, several questions present themselves with regard to what is the best way to structure, implement, and evaluate the CLEAR program at the North Carolina Department of Transportation. Below, I break these questions down by key categorical facets of the knowledge management (KM) initiative.

18. Cultural Facets

1. *Are high-level NCDOT officials committed to the long-term viability of the CLEAR program?* As noted in this report, without overt and ongoing support from top managers, KM initiatives nearly always fail. High level managers at NCDOT need to be informed of their critical long-term role. In cases of tepid support levels, it must be made clear that any show of non-support from high-level officials will seriously hamper the program.
2. *Are the short- and long-term goals of the CLEAR program clearly defined?* KM programs cannot be a solution in search of a problem. NCDOT employees at all levels must be able to clearly and succinctly recite the organizational goals for which the CLEAR program is the answer. This process begins with top management.
3. *Are sufficient financial and human resources dedicated to the long-term viability of the CLEAR program?* While no program success is ever guaranteed, without proper support (beyond rollout), most initiatives either fail or reach sub-optimal results.
4. *Is the organizational culture open to individual recognition for knowledge contributors and subject matter experts or is individualization shunned?* This question has ramifications for how to organize the knowledge system. For instance, should contributors and reviewers of knowledge be directly referenced in the database or not? If employees are driven more by mission/task accomplishment or personal satisfaction than individual recognition, the platform should reflect this.
5. *How likely is it that there will be organizational resistance to the CLEAR program and from where is it likely to arise?* Most major initiatives face internal resistance. Resistance can be political, structural, cultural, or individual. Prior to launch, it is important to identify any potential areas of resistance and seek to prevent or mitigate them to the greatest degree possible.
6. *Are there any hierarchical or functional frictions across NCDOT that will make implementation of a knowledge sharing culture problematic?* In order for the CLEAR program to be successful, knowledge must be able to be freely shared across functional silos and across supervisory levels. KM communication sharing needs to be "flat" regardless of the organizational structures currently in place.

19. Individual Facets

1. *Are field level managers in the NCDOT supportive of the CLEAR program?* These individuals are the closest level of management to individual employees who will use the KM system. It is essential to obtain program buy-in from as many of them as possible. A loss of support at the local level can easily result in depressed knowledge sharing.
2. *Can knowledge champions be identified and recruited at the divisional level?* Champions for both the CLEAR program in general and champions for appropriate skills and situational expertise in particular must be identified and "socialized."
3. *Do rank and file NCDOT employees have the requisite skill level to successfully implement the CLEAR program?* This question relates primarily to the level of technological prowess that is necessary to interact on the CLEAR program platforms.
4. *What are the available and relevant methods of compensation/reward for individual and team participation in the CLEAR program?* The success of the CLEAR program depends upon the voluntary engagement of employees. These individuals must be motivated to

participate. That motivation is often idiosyncratic, but an analysis of which financial and non-financial incentives are applicable would be beneficial to the development of the KM platform.

20. Knowledge Facets

1. *Can the organization distinguish between explicit and implicit knowledge?* For each participating division of the NCDOT, it is important to distinguish between explicit and tacit knowledge. This has implications for how information is stored (e.g., database or individual), how it is reported in a technical platform, and how it is shared (e.g., database or individual) across the organization.
2. *Does explicit and implicit knowledge vary across divisions or departments?* This follows from the previous question and could mean that there is a slightly different format or network structure for each division.
3. *Can individual holders of critical knowledge (i.e., subject matter experts) be easily identified?* Without conducting an expensive and time-consuming network analysis, can each division of the NCDOT catalogue what the critical areas of implicit knowledge are as well as who(m) the expert in that area is. Can there be a cross-divisional network identified as well? This will help to facilitate the sharing of crucial implicit information.
4. *Can the subject matter experts be persuaded to actively serve as a team, divisional, or organizational point of contact within a knowledge network?* Serving as a champion or subject matter expert takes time away from an individual's primary job tasks. There must be some form of compensation to attract and retain individuals to serve in this capacity.

21. Technology Facets

1. *Does the NCDOT currently have the technical capacity to successfully launch and continuously support the CLEAR program?* Does the NCDOT currently have sufficient staff and resources to undertake the new initiative? If not, resources should be sourced prior to launch.
2. *Are appropriate tools being developed to capture both explicit and implicit knowledge objects?* Both types of knowledge assets need to be identified, rated for programmatic value, and assigned to a particular form of acquisition and retention. Senior managers and IT professionals must develop a plan for capturing and disseminating both types of knowledge.
3. *Do the tools on the technical platform fit as seamlessly as possible with current tools?* If the CLEAR platform for knowledge acquisition and transmission is not adequately similar to the current social form of interaction, the initiative will be resisted and inadequately used.
4. *Will the IT personnel at NCDOT be able to both train employees on the new platform and be available to provide technical support on an ongoing basis?* This question focuses on the available equipment, financial capital, human capital, and bandwidth of the NCDOT IT staff to launch and support the initiative over an extended time. Failure to do so at any stage in the program's evolution will be harmful.
5. *Are the technical tools necessary for the CLEAR program available where and when individuals need to use them?* The answer to this question might vary across NCDOT divisions. In essence, the CLEAR tools (knowledge inputs/outputs) must be readily available to individuals (e.g., office, field, mobile) in order for the platform to be utilized. Knowledge

will rarely be "saved for later" and will need to be readily accessible if the platform is to be widely used.

RECOMMENDATIONS

Quantitative and qualitative results from this research initiative coupled with insights from the initial pilot program rollout and knowledge management programs' best practices provide the NCDOT with strong insights with which to begin advancing the CLEAR rollout to the entire organization. The findings and implications for the organization are as follows:

The NCDOT is starting from a position of strength with respect to rolling out a knowledge management program. According to scholastic research, this is an anomaly to most non-profit or governmental organizations (NFP). Many employees (~60%) view the NCDOT as "an innovative agency." Moreover, an overwhelming majority indicated a high level of interest in participating in work that is innovation-oriented.[26]

1. The CLEAR program must freeride off of this extant perception and reinforce how the initiative serves to further advance the cause of innovation and knowledge capture at NCDOT. It should be communicated as an opportunity to contribute "cross-unit/division" knowledge" that is "now available to everyone" as a result of "newly available technology," which was developed due to "requests by NCDOT employees."

There are pockets of weakness, however, with approximately 40% of employees who do not view the agency as innovative. While a minority, this is not an insubstantial number of individuals. As previously noted, the Aviation and Hydraulics units were selected for the initial pilot rollout because their leadership and employees who were pre-determined to be positively biased in favor of innovation and knowledge management initiatives. Yet, even these employees were relatively unclear about how to advance innovative ideas and how those ideas would be evaluated.

2. The CLEAR program must clearly communicate a centralized/formalized process (with appropriate unit/division variations) by which CLEAR will be instituted as well clearly indicate how submissions will be evaluated and by whom. A weighted scorecard should be developed (e.g., STIC-influenced, ROI-influenced) to shape internal evaluations. A simplified scorecard could be developed to communicate to employees and shape their expectations and submissions.

NCDOT employees are service- and task-oriented. As noted in the Deliverable #1 report, this is a common trait in NFP employees. While research often notes this as a negative trait[27], the NCDOT survey results indicate that it might be more of a double-edged phenomenon. Specifically, employees were generally open-minded to department-wide innovations as well as to structural changes.

[26] This inclination is relatively strongest among employees with 1-10 years of experience.
[27] The *profit motive* of employees in for-profit organizations is widely credited for advancing employee acceptance of knowledge management programs. The lack thereof in NFPs is generally viewed as a barrier to acceptance.

3. The CLEAR program must make a clear linkage (in the minds of employees) between the innate service-orientation of the organization and the goals of the knowledge management program. This messaging should be part of the overall communication strategy and should accompany the "employee driven" communications that were recently instituted in the pilot rollout meeting.

NCDOT employees feel empowered and encouraged to participate in bringing innovation to their daily work duties. The support and encouragement of their "direct management" was noted as the primary driver of this feeling. Recent technological introductions also played a key role here.

4. The CLEAR program must use unit and/or division level managers as the primary individuals to advance the initiative – not upper level employees. Unit managers should be trained on the conceptual, practical, and communication aspects of the CLEAR program prior to rollout to their respective employees. Use of the CLEAR portal and submission of innovative ideas should be a regular topic at unit and/or division meetings. Likewise, occasional meetings solely dedicated to innovation and knowledge management should occur at the unit/division level. The IT resources available via the CLEAR program should also be overtly (and regularly) communicated to employees.

NCDOT employees prefer to engage in small groups. The Deliverable #1 report noted that the CLEAR program should consider how employees currently interact and strive to fit the initiative within current cultural norms of interaction. 60% of employees indicated that word-of-mouth was their primary method of communication regarding innovation, which ties into the "small group" results. Workshops and webinars were also noted as current modes of knowledge transfer as well as modes that employees are generally comfortable with. While a minority of employees, a substantial number of individuals indicated a willingness to engage in offsite experiences (during non-working hours) and even contests or competitions.

5. The CLEAR program must predominantly use unit or division level engagements (be they workshops, webinars, contests, etc.) as opposed to organization-wide engagements. Following the "think global, act local" mantra is good advice as the NCDOT rolls out the initiative. Unit and/or division level managers (or local level designated "knowledge champions") should serve as the focal leaders for most engagements. As the program expands, unit/division leaders from previously rolled out units/divisions should serve as "guest speakers" at new rollouts. Upper level management should play a relatively minor visible role during rollouts. Engagements should be held at the local level (v. Raleigh) where possible. Even on-line interactions should be limited to a single (or small number of) unit/division.

Innovation is an intimate concept for NCDOT employees. While approximately one-quarter of employees indicate that they have personally submitted or designed something innovative during their tenure at NCDOT, 80% of employees have witnessed innovations impacting their daily work experience. This might account for the large number of individuals who see the organization as "innovative." These employees credited things like meeting in small groups, having appropriate resources (e.g., time, money), and having a tolerance for failure as driving forces behind these innovations.

6. The CLEAR program must freeride off of the history of innovation at the NCDOT. The message that CLEAR is "employee driven" and that the program is a "bottom up" initiative must be communicated clearly and consistently. Employees – and their past successes – should be the focal point of communications. This should occur regularly at the local unit/division level, but stories of success in other (perhaps complementary) units/divisions should also be shared. Managers must encourage employees to devote time to contemplating and sharing innovative ideas. Incentives (both monetary and non-monetary) must be developed to help motivate and shape behavior.

Some NCDOT employees have experienced resistance to personal attempts to promote innovation. Roughly 30% of individuals claim to have personally experienced someone or something thwarting their attempts to advance innovation. While several specific causes for the resistance were noted by employees, they each fall into approximately three key areas: (a) cultural resistance, (b) leadership support issues, and (c) resource constraints (financial, human, technical, time). What is interesting is that while (a) and (b) are noted as barriers to innovation, these same areas were noted by other employees as facilitators of innovation. This might indicate variance in unit/division leadership and/or sub-cultural differences in the NCDOT.

7. The CLEAR program must identify those unit and/or division leaders who will actively support and promote the initiative. They must be trained in the specifics of the program and their units/divisions should be among the first ones to which CLEAR is rolled out. This will help to positively impact the organization-wide rollout by accomplishing a few things: (a) early adopters of CLEAR can serve as positive evangelists for subsequent units/divisions; (b) creating an "exclusivity" effect of an invitation-only rollout (and overtly promoting success stories), will induce other units/divisions to seek out inclusion in the rollout process; (c) employees across the organization will witness the positive aspects of innovation and knowledge management, whereby non- or less-supportive leaders are more likely to be positively socialized by their peers. Unit and/or division leaders should overtly and regularly support the CLEAR program and encourage their direct reports to participate. Appropriate resources should be allocated to help facilitate the notion that contributions to the CLEAR portal and the innovation process are welcome. IT advancements associated with the program should be communicated to employees and training on IT systems should be replete across the organization. It should also be communicated that the CLEAR program evolved as a "bottom-up" initiative in response to employees who sought greater innovation at the NCDOT. While top management support is necessary for the initiative to persist, employees need to be empowered and to take ownership of the program for long-term cultural and behavioral change to occur.

A substantial number (30%) of NCDOT employees do not feel encouraged to be innovative. The reasons cited evoke a similar thread to those mentioned previously: (a) lack of leadership support, (b) lack of resources (financial, technology), (c) cultural resistance, and (d) lack of follow-up. Again, there is an interesting juxtaposition as many of these factors are listed by both those who do and those who do not feel encouraged to be innovative. Without more specific information at this time, it appears that certain factors might be at play.
First, it could be a leadership issue at the unit/division level. While some leaders overtly support innovation, others might suppress or discourage it (for any variety of reasons). Second, it could be a lack of information regarding intentions or resources. Technological advances might not

have been broadly communicated or there could be gaps in technology depending upon job functions or locations. Third, there is a possibility that the NCDOT is comprised of multiple sub-cultures (as opposed to a general organizational culture) that are largely influenced by local leaders and job responsibilities. Finally, the nature of the job responsibilities coupled with managerial expectations of performance might simply not allow sufficient time for employees to "be innovative."

8. The CLEAR program must be structured so that it accentuates those factors that are positive influences and mitigates those that are negative. A positive disposition from leaders at all levels is important. It is vital that unit/division leaders reflect this. Where resources exist but are perceived to not exist, communication of the availability of resources (e.g., time, technology, money) should be initiated. Where resources are actually scarce, efforts should be made to accommodate them or develop alternatives until resources are available. Culture is a tricky proposition and, as noted in the Deliverable #1 report, perhaps the greatest barrier to organizational change. The CLEAR program should initially focus on positively biased units/divisions for rollouts, moving then to complementary units/divisions (e.g., Hydraulics first, then Roadway or Project Standards units) saving less enthusiastic units/divisions for later in the organizational rollout. This phased and selective approach, coupled with ongoing organization-wide communication of the process, will help to positively shape the actions of leaders and employees of relatively more resistant units/divisions.

The Innovation Culture Index (ICI) survey was developed to: (a) provide the NCDOT with a baseline of employee perceptions and (b) serve as a quantitative mechanism to gauge the effectiveness of the CLEAR program in future years. The ICI survey has now been administered to multiple units of the NCDOT[28] as part of the pilot rollouts and there now are sufficient results to begin to develop insights from the survey. In summary, the general conclusions from this report are as follows:

1. NCDOT employees are generally positively predisposed toward innovation and knowledge sharing in the organization. Employees are comfortable sharing ideas and clearly understand that innovation and knowledge sharing is important to the organization. This is an anomaly in most non-profit organizations and provides NCDOT leadership with a solid cornerstone upon which to build the CLEAR program.
2. While the initial results of the ICI survey are generally positive in nature, the variance in perceptions across employees is quite large and indicates that opinions about issues related to innovation and knowledge management are varied. Differences in perceptions are often related to length of tenure with the Department as well as the unit or division of employment. This indicates that a uniform, one-size-fits-all approach might not be warranted.
3. Knowledge sharing *within* units/divisions exists to some degree, albeit non-uniform; but, knowledge sharing *across* units/divisions is sparse at present.
4. The training of front-line managers is crucial to the continued development and success of the CLEAR initiative. Front-line managers will play a crucial role in the CLEAR program.

[28] Please note that the ICI survey was administered at the beginning of a CLEAR rollout meeting to the employee's unit/division. The reported survey results were taken prior to any employee's knowledge of CLEAR or its purpose.

5. Executive level buy-in and support for CLEAR is essential. Perceptions concerning current levels of support for innovation and knowledge sharing is generally favorable, but mixed.
6. Employees are generally unware of how or where to submit any innovative ideas that they might have. Likewise, there is little understanding of how ideas would be evaluated even if submitted. See footnote 1.
7. There is an overall lack of employee awareness that the NCDOT has employees who are dedicated to innovation and knowledge sharing. See footnote 1.
8. There are noticeable differences in perceptions between employees who predominantly work in teams versus those who work in an individualistic environment. Perceptions about innovation and knowledge sharing are statistically, and overwhelmingly, more positive among those individuals who work in teams.

While the peer exchange conversations were relatively brief, the information gleaned from them has specific implications for NCDOT and CLEAR. Some specific ideas and issues to consider might include:

1. Potential redesign of the CLEAR portal to incorporate a *dashboard*-type interface that is relevant to the NCDOT audiences (e.g., employees, management, elected officials, etc.). While the CLEAR portal is an internal medium, an externally focused dashboard could be developed as well. A behind the scenes, formal scoring card for vetting submissions could be developed, if helpful. A simplified, public version of this could help shape employee submissions.
2. While not formally being broached until the Deliverable #5 report, a communication strategy for the NCDOT is being discussed informally (e.g., bottom-up messaging, unit-level evangelism of CLEAR, etc.). The *storytelling* concept would work well as part of a unit-level communication approach. Cross-division/unit storytelling (e.g., during rollout meetings) would also be beneficial.
3. *Employee engagement events* should be developed for the point at which CLEAR has been rolled out to a substantive portion of the organization. Once there is a critical mass of employees who have been trained on the CLEAR system and approach, such events can serve to fuel new innovative ideas. Formats (e.g., competitions, ideathons, challenges, etc.) that are appropriate to the NCDOT culture should be developed and, where possible, designed so that they persist over time. Any event initiated should <u>not</u> be a one-shot event.
4. Appropriate *awards* should be developed. These should be monetary and non-monetary in nature (as appropriate to NCDOT cultural norms) and should be persistent in nature so that employees see the permanence of the CLEAR program. In addition to exploring EDC and STIC funding for awards or event underwriting, private organizations should be approached to help with financial support.
5. The issue of *ROI* needs to be fully explored as it relates to CLEAR. Metrics should be appropriate to either the organization or the innovation (e.g., dollars or time). Development of these metrics should incorporate a wide variety of NCDOT employees and relevant stakeholders. This is an issue that will have long-term implications for the CLEAR program. It will also help to align employee engagement with the initiative and the types of ideas submitted.
6. Given the current and likely near-future budgetary constraints on the state of North Carolina, *funding* will likely be an issue going forward. It will be imperative that CLEAR be driven by institutionalized employee behaviors. STIC, EDC6, and external funding should be used to

support activities, events, and initiatives that will drive organizational behaviors that are conducive to CLEAR. Creativity will be key.

7. The CLEAR program has already put in place several of the ideas put forth by the peer exchange participants. There is a formal process via the portal. Submissions are tracked and vetted. Innovation champions have been identified and trained. Anecdotally, the CLEAR program appears to be more advanced than many of the innovation programs presented in the peer exchange. Some nuanced changes will be necessary as we learn from the pilot rollouts and from peer institutions, but the core of the initiative appears solid.

Unit and division managers involved in the pilot and first wave program rollouts are crucial to both the short- and long-term success of CLEAR at the NCDOT. These individuals were hand selected to be part of the initial rollouts because they personally, and/or their units generally, were deemed to be innovation-oriented and positively biased toward the principles of the CLEAR program. Unit and division managers involved in the second wave are also crucial to the overall success of the program. Their role in the communication plan is vital and multi-faceted. Key aspects of the front-line manager role are detailed below:

1. *Motivate employees*: As front-line leaders, these individuals are critical in motivating individuals on their teams to actively engage in the CLEAR program. Preliminary data from NCDOT employees indicates that the unit culture might be stronger than an overall Department culture. Front-line employees will likely follow the lead of their unit or division managers.
2. *Local knowledge experts*. If these managers are not designated as the knowledge champion or expert for their unit, then they must identify such a person and actively promote the role of the local knowledge expert. Future candidates for this role should also be identified and groomed to respond to promotions or retirements.
3. *Socialization champions*. Front-line managers must instill a culture of knowledge sharing and innovation in their respective units/divisions. This requires not only support of the CLEAR program but also consistent communication of the program at meetings and other gathering points for their employees.
4. *Peer support*. Front-line managers should overtly and actively support peers in other units or divisions. This can include activities such as guest speaking at unit rollouts or general meetings, holding joint unit/division meetings, sponsoring innovation contests, or openly sharing information with peer units/divisions. These interactions should be overt in that front-line employees from multiple units/divisions should be clearly aware of cross-unit collaboration at the front-line manager level.

While the role of front-line managers is crucial to the success of the CLEAR program, the role of senior management is of utmost importance as well. The degree of communication to and interaction with front-line employees is relatively less than that of front-line managers, but the failure of senior managers to *overtly* and *consistently* support knowledge management programs is a common predicate for program failure at large organizations. Key aspects of their role are detailed below:

1. *Program support*. It is important that senior managers become educated on the central facets of the CLEAR program and overtly support the program. This support can be communicated

in a variety of ways such as direct communications, audio or video recorded support, proxy support via others, or sponsorship of program activities and initiatives among other things.
2. *Motivate front-line managers*. Senior managers must clearly communicate to front-line managers that the CLEAR program is important to the *organization* and that senior management will monitor the activities and results of each unit or division as the CLEAR program expands. The celebration of successes and the punishment of failures to actively participate will help to socialize front-line managers.
3. *Long-term support*. Program support must be long-term oriented in that while initial senior management support of the CLEAR program will motivate employees at all levels to engage at the rollout stage of the program, that support will erode over time if employees are not occasionally reminded that top management remains committed to the initiative.

IMPLEMENTATION OF TECHNOLOGY TRANSFER PLAN

Findings and research implications from this research have already been implemented as the CLEAR program has developed, evolved, and been rolled out to NCDOT units since March 2020. Training and communications plans have been initiated. The ICI survey will be used to assess the effectiveness of CLEAR annually going forward. Dashboards are in development. Implementation is already underway.

CITED REFERENCES

Adler, J. (2020), "SWOT model and value proposition for crowdsourced data," USDOT ITS Joint Program Office, online presentation.

Ballantine, D. (2000), "Internal relationship marketing: A strategy for knowledge renewal," *International Journal of Bank Marketing*, 18(6), 274-80.

Burk, Mike (1999), "Knowledge management: Everyone benefits by sharing information," *Federal Highway Administration Research and Technology*, 63(3), 1-6.

Bryan, L. (2004), "Making a market in knowledge," *The McKinsey Quarterly*, Vol. 3, 101-11.

Chang, C. and T-C. Lin (2015), "The role of organizational culture in the knowledge management process," *Journal of Knowledge Management*, 19(3), 433-55.

Choi, T. and S. Chandler (2020), "Knowledge vacuum: An organizational learning dynamic of how e-government innovations fail," *Government Information Quarterly*, 37, 1-11.

Chong, S. and Y. Choi (2005), "Critical factors in the successful implementation of knowledge management," *Journal of Knowledge Management Practice*, 5, 253-61.

Cohen, W. and D. Levinthal (1990), "Absorptive capacity: A new perspective on learning and innovation," *Administrative Science Quarterly*, 35, 128-52.

Colyar, J. and P. Jodoin, "Crowdsourcing for operations," *Federal Highway Administration, www.fhwa.dot.gov/.*

Davenport, T. (1998), "Successful knowledge management projects," *Sloan Management Review*, Winter, 43-54.

Dixon, N. (2000), *Corporate knowledge: How companies thrive by sharing what they know*, Harvard Business Press, Boston.

Donahue, K. (2001), "Knowledge management: Beyond databases," *Harvard Management Update*, 1-2.

Gilmore, D. (2003), "How to fix knowledge management," *Harvard Business Review*, October, 16-17.

Goh, S. (2002), "Managing effective knowledge transfer: An integrative framework and some practice implications," *Journal of Knowledge Management*, 6(1), 23-30.

Henard, D. and A. McFadyen (2006), "R&D knowledge is power," *Research-Technology Management*, May-June, 41-7.

Henard, D. and A. McFadyen (2008), "Making knowledge workers more creative," *Research-Technology Management*, March-April, 40-6.

Hume, C., et al. (2012a), "KM 100: Introductory knowledge management for not-for-profit organisations," *International Journal of Organisational Behaviour*," 17(2), 56-71.

Hume, C., et al. (2012b), "The role of knowledge management in the large nonprofit firm: Building a framework for KM success," *International Journal of Organisational Behaviour*," 17(3), 82-104.

Hume, C. and M. Hume (2015), "The critical role of internal marketing in knowledge management in not-for-profit organizations," *Journal of Nonprofit & Public Sector Marketing*, 27, 23-47.

Hume, C. and M. Hume (2016), "What about us? Exploring small to medium Australian not-for-profit firms and knowledge management," *Journal of Knowledge Management*, 20(1), 104-24.

Ihrig, M., M. Boisot, and I. MacMillan (2011), "Are you wasting money on useless knowledge management?" *Harvard Business Review*, Jan., 1-4.

Im, S. et al. (2016), "How knowledge management capabilities help leverage knowledge resources and strategic orientation for new product advantages in B-to-B high-technology firms," *Journal of Business-to-Business Marketing*, 23, 87-110.

Jaworski, B. and A. Kohli (1993), "Market orientation: Antecedents and consequences," *Journal of Marketing*, 57(3), 57-70.

Lang, J. (2001), "Managerial concerns in knowledge management," *Journal of Knowledge Management*, 5(1), 43-59.

Lettieri, E., et al. (2004), "Knowledge management in non-profit organizations," *Journal of Knowledge Management*, 8(6), 16-30.

Lin, C., et al. (2011), "Exploring barriers to knowledge flow at different knowledge management maturity stages," *Information & Management*, 49(1), 10-23.

Lorenz, J. et al. (2018), "Guide to Creating and Sustaining a Culture of Innovation for Departments of Transportation," NCHRP Research Report 885, 1-71.

Malhotra, A. et al., (2017), "Developing innovative solutions through internal crowdsourcing," *Sloan Management Review*, Summer, 73-9.

March, A. and D. Gavin (1997), "A note on knowledge management," *Harvard Business School*, Nov., 398-031, 1-20.

Peters, D. (2000), "Knowledge management: Four practical steps," *Harvard Management Update*, 1.

Riege, A. (2005), "Three-dozen knowledge sharing barriers managers must consider," *Journal of Knowledge Management*, 9(3), 18-35.

Rossi, G., A. Garlatti, and C. Leardini (2015), "How to engage stakeholder knowledge in decision-making: A case study from the non-profit sector," *Academic Conferences International Limited*, 1-6.

Salgado, S. et al., (forthcoming 2020), "Innovation and the co-creation experience for customers: Exploring the role of perceived challenge," *Journal of Business Research*.

Spender, J-C. (1996), "Making knowledge the basis of a dynamic theory of the firm," *Strategic Management Journal*, 17(4), 45-62.

Swanson, L. (2013), "A strategic engagement framework for nonprofits," *Nonprofit Management & Leadership*, 23(3), 303-23.

Taylor, M. and A. Taylor (2013), "Performance measurement in the third sector: The development of a stakeholder-focused research agenda," *Production Planning & Control: The Management of Operations*, 25(3), 35-61.

Valentine, M. (2018), "Renegotiating spheres of obligation: The role of hierarchy in organizational learning," *Administrative Science Quarterly*, 63(3), 570-606.

Wenger, E. and W. Snyder (2000), "Communities of practice: The organizational frontier," *Harvard Business Review*, 78(1), 139-45.

APPENDICES

A. Innovation Culture Index (ICI) Survey Items

1. The topic of innovation is regularly discussed at our division/unit staff meetings.
2. My division/unit actively encourages employees to submit innovative ideas on a regular basis.
3. I feel comfortable offering my ideas on innovative improvements to my peers.
4. I feel comfortable offering my ideas on innovative improvements to my managers.
5. Successful innovative ideas are rewarded in my division/unit.
6. Successful innovative ideas are openly shared across my division/unit.
7. My division/unit has a formal process for submitting innovative ideas.
8. If I submit an innovative idea, I clearly know how that idea will be evaluated by others.
9. I am encouraged to spend work time thinking about innovative ways to improve my division/unit.
10. It is clear to me why innovation and knowledge sharing is important to the NCDOT.
11. My division/unit shares innovative ideas from other divisions that might be helpful to us.
12. NCDOT executive level managers actively support and promote innovation.
13. My division/unit level managers actively support and promote innovation.
14. If I have an innovative idea, I clearly know whom to tell it to.
15. My division/unit has a designated "innovation champion" who leads our innovation efforts.
16. Several people in the NCDOT act as "innovation champions."
17. How many years of work experience do you have with the NCDOT?

    - Less than 5 years
    - 6-10 years
    - 11-15 years
    - 16-20 years
    - More than 20 years

18. Which of the following best represents how your typical job responsibilities are divided?

    - 100% in the field
    - 75% field / 25% office
    - 50% field / 50% office
    - 25% field / 75% office
    - 100% in the office

19. Which of the following best describes your typical job responsibilities?

    - I usually work as part of a team
    - I usually work as an individual

20. Which of the following best describes your typical job responsibilities?

    - I manage staff
    - I manage multiple teams of individuals
    - I manage one team of individuals
    - I do not manage any teams

21. Which of the following divisions/unit best describes where you conduct your daily job responsibilities? (drop-down menu)

22. Please list below any additional comments that you think would be useful in helping to promote a culture of innovation and knowledge sharing in the NCDOT.

B. List of Acronyms/Abbreviations and Definitions

CLEAR	Communicate Lessons, Exchange, Advice, Record
FHWA	Federal Highway Administration
IT	Information Technology
IMC	Internal Marketing Communication
KM	Knowledge Management
NFP	Not for Profit, Non-profit
ROI	Return on Investment
STIC	State Transportation Innovation Council
USDOT	United States Department of Transportation