HUMAN-CENTERED COMPUTING

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Franchise Experts

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This article harks back to the origins of this periodical as *IEEE Expert Systems*. Even while expert systems as a field or paradigm was morphing into intelligent systems, it was recognized that cognitive task analysis was critical in the design of new technologies. Furthermore, as a part of cognitive task analysis, it is crucial to conduct some form of proficiency scale to help identify the experts whose knowledge and skill might be revealed and specified in the creation of reasoning and knowledge-based systems.

In this article, we will advance the claim that identifying and studying *franchise experts* can contribute to the design of intelligent systems. Of further interest is the possibility that the knowledge elicited from such experts might be invaluable for the practice of accelerated learning.[1]

Defining Franchise Expertise

In professional sports, we sometimes hear of *franchise players*, individuals whose performance surpasses that of their best teammates and whose presence and contributions are identified with the spirit of the organization. The following example illustrates how we can apply this concept to experts:

> John Jones was a technical services manager at an electric utility. He supervised power quality engineers and district reliability engineers. Since childhood, he had an interest in electronics, mechanics, and engineering. While employed at the company, he sought out learning opportunities. "I learn on my own. I research and dig out the facts I need to know. Specialized training for engineering and construction is fun and neat to do." He worked for the company for about 30 years, in positions including distribution engineer, construction services supervisor, engineering division manager, power

delivery manager, and reliability supervisor. He knew the company from top to bottom. Technology upgrades, staffing and training, production pressures, and the historical evolution of the system's complexity were all in play continuously, all needing to be orchestrated in the face of changing conditions to guard the corporate mission of reliable, safe electricity distribution. His knowledge of regulatory activities, including his knowledge of and strategies for liaising with the Public Services Commission, were tacit knowledge—undocumented and crucial to the company.

Thus, we refer to "franchise" experts because they are not only expert in their chosen technical domain but also expert with regard to the organizations to which they belong. The concept map in Figure 1 provides an overview of this individual's expertise. As a concept map organizer within a "knowledge model,"[2] some of the nodes are appended with icons that link to other concept maps that drill down into details, technical documentation, schematics, URLs, and so forth. This concept map shows that the franchise expert's knowledge refers to organizational structures and topics.

Proficiency Scaling

There is a classic claim that the development of high proficiency takes at least 10 years. No one spends all their time at work actually performing job-related tasks. A rule of thumb, based on classic studies of work,[3] is that only half of the time people are at work is actually spent doing job-related tasks. To achieve expertise, the metric generally cited is 10,000 hours of actual time on task.[4]

If we were to say "10,000 ± 2,000," this would be reasonable enough as a general estimate of the minimum time to achieve expertise.[5,6] There are
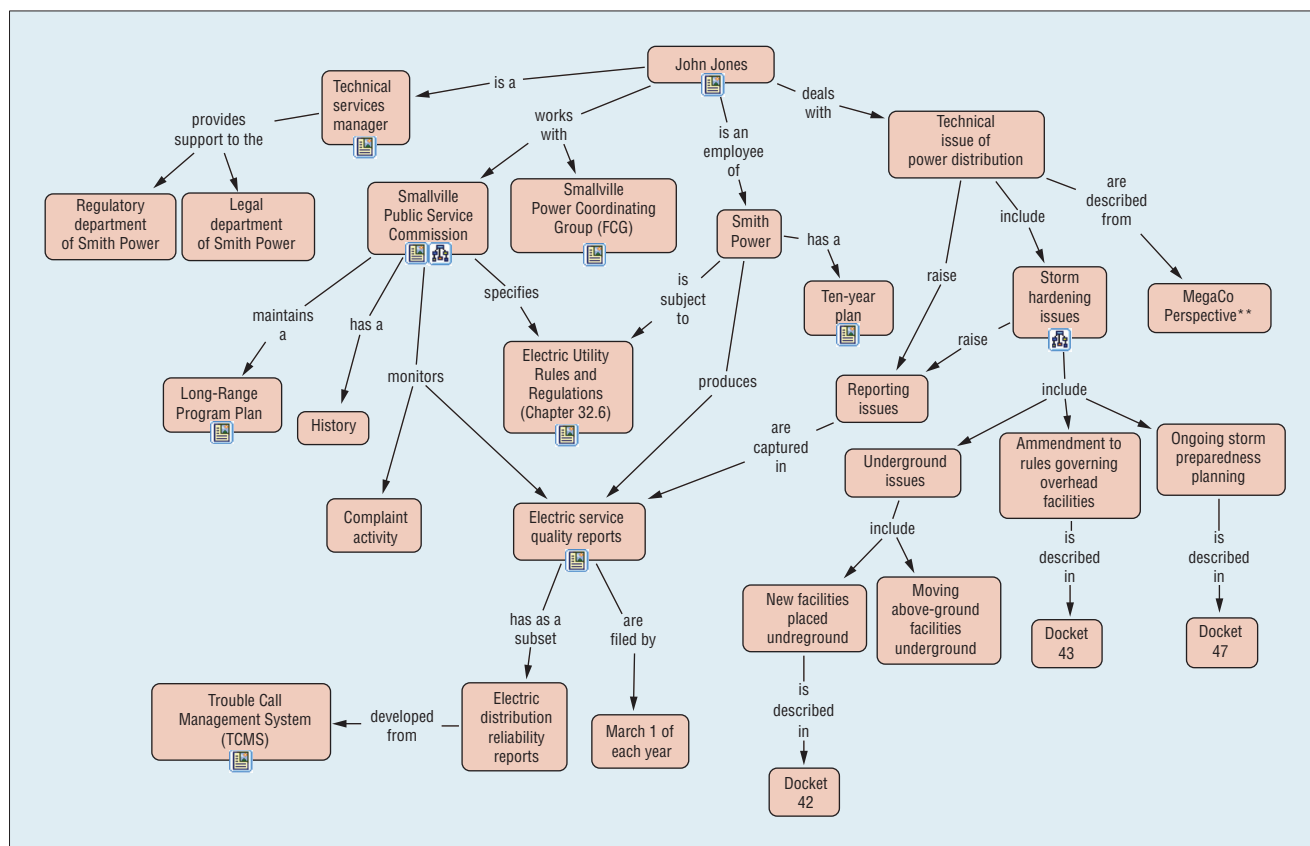
Figure 1. Concept map overview of a franchise expert's knowledge areas. The icons appended to some of the nodes link to resources, including other concept maps that drill down into details, technical documentation, schematics, URLs, and so forth.

additional considerations, however. For instance, an in-depth study of weather forecasters spanning the full proficiency range (from apprentice to journeyman to expert) estimated that the best forecasters—senior citizens—had spent as much as 50,000 hours on task.[7] In addition to looking at time on task, of course, we must consider actual performance (forecast skill scores for senior experts were greater than those for junior journeymen) and depth of experience as well (the senior experts had a greater variety of experiences, such as forecasting in multiple climates). Similarly, Jim Shanteau pointed out that someone might remain a novice in the judging of livestock even after 10 years of experience (typically at school and club training) and that experts are those with 20 to 30 years of experience.[8,9]

To achieve expertise, there needs to be

- a constant stretching of skills, defined by increasing challenges (such as tough or rare cases);
- high levels of intrinsic motivation to work hard, on hard problems, which pioneer educational psychologist Edwin Thorndike[10] called "practice with zeal;"
- practice that provides rich and meaningful feedback about both process and outcome; and
- opportunities to practice with the help of a mentor (for the apprentice-to-journeyman progression) or some form of more-expert instructional guidance (for the journeyman-to-expert progression).

These sorts of findings about expertise hold for domains ranging from musical performance to world-class sports performance to scientific and engineering domains.[6,11,12]

Robert Hoffman defined the expert as

The distinguished or brilliant journeyman, highly regarded by peers, whose judgments are uncommonly accurate and reliable, whose performance shows consummate skill and economy of effort, and who can deal effectively with certain types of rare or "tough" cases. Also, an expert is one who has special skills or knowledge derived from extensive experience with subdomains.[13]

Some experts become extraordinary because of

- a personal choice to become a student of what interests them,

- a lack of barriers to their success, and
- some kind of positive feedback or mentoring that encourages their success.

This finding fits with results of previous studies of expert weather forecasters.[7,14] It is common for top performing weather forecasters to report an early fascination with the weather, leading in adulthood to an intrinsic motive to continue learning and developing higher levels of skill.

But not all experts have such an attitude and approach. Rebecca Pliske, Beth Crandall, and Gary Klein found that some weather forecasters were highly proficient, but were demotivated.[12] These had a *proceduralist attitude* of merely going through the motions in their job, whereas others had a *scientist attitude* marked by a desire to keep learning and improving.

Thus, it is possible to draw some distinctions within this single, grand category of "expert."

One-Percenters versus Five-Percenters

Across the literature, we sometimes see reference to experts who are *five-percenters*. A study of expert computer programmers affirmed a previous finding in expertise studies, namely that experts begin problem solving by thinking about general principles before moving to the analysis of details.[15] The researchers compared experts (determined to perform at the 70th to 80th percentile level) to super-experts, who were determined to perform in the top 95th percentile. The full proficiency scale created in a study of weather forecasters found it useful to distinguish junior and senior grades within each of the main categories of apprentice, journeyman, and expert.[7] On this expanded scale, we might informally refer to the senior expert as a *one-percenter.*

Although all experts have rich mental models, the one-percenters form mental models that go beyond those of their expert colleagues. When one-percenters generate an answer, they anticipate consequences throughout the work system or organization, in addition to the collateral consequences to other related systems or subsystems. Like all experts, one-percenters have knowledge and reasoning strategies that are not easy to write down. It might be difficult to formally model their knowledge and skills.

All experts learn from mistakes, but one-percenters retain a remarkably vivid recall of their errors. For example, proceduralists might be all too ready to forget their last faux

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pas, while one-percenters think about their past mistakes, which both gall and intrigue them. They revisit their performance, and revisit again, searching for the ways they were tripped up and considering what they could have done differently.

Like all experts, one-percenters can deal with tough cases. They recognize that to achieve the mission, work needs to be done at the edge of the familiar. They take satisfaction in opportunities to do work beyond their comfort zone, and examples of their best work are exhibited where the work is conducted beyond that edge of the familiar.

All experts are willing to improvise in challenging or unusual situations.

However, one-percenters often demonstrate greater confidence and willingness in doing so. One-percenters not only recognize the anomalous, they seek it out. What they are not comfortable with is ignorance. They engage in problem solving to make sense of things and do not like to throw in the towel. When they say, "I've never seen this," their eyes light up, whereas others might say, "We do not have procedures for this."

One-Percenters versus Franchise Experts

Experts and senior experts in the utilities industry maintain that status for the last 15 to 25 years of their employment. This large proportion of utility personnel have simply become very, very good at what they do. This would not be inconsistent with the scientific conclusion about how long it takes people to achieve expertise as a five-percenter.[6]

We have elicited knowledge from dozens of utilities workers and have conducted workshops on workforce and training issues in the utilities. During the course of these interviews, we have encountered some individuals who triggered our thoughts about the concept of the franchise expert: a technical services manager, a training officer, a labor relations officer, a turbine repair technician, an environmental quality assurance officer, and a chief executive officer. The ways in which franchise experts stand apart from one-percenters have to do with the understanding they have about their organization and their relationships to it.

They have unique incentives. Franchise experts certainly expect to be compensated. But typical compensation packages are not the only, or even most important, rewards they seek. Technical achievements (such as

problem solving and invention) are the things that motivate them.

They are an ad hoc solution provider. Franchise experts, by virtue of their continuously demonstrated success, become the go-to pro. People depend on them for mission critical, complex technical guidance or high-stakes decision making. Colleagues use the franchise expert's phone number as a hotline. Franchise experts routinely receive requests for help, to which they readily respond, even if the response requires additional effort.

A franchise expert's absence is traumatic. For colleagues that rely on the franchise expert, the absence of a franchise expert (due to a vacation or sick leave, for example) can be a traumatic event. The only circumstance that is more dreadful is to be placed in the role of the franchise expert during the franchise expert's leave.

They rarely say, "This is what I believe." Franchise experts do not support their actions or judgments by citing their own authority. They know that that is neither sufficient nor helpful to colleagues.

They appreciate the perspectives of others. While some experts become engrossed in the problem at hand, franchise experts consider the perspectives of others who are involved in the situation. They not only have the ability to do that, they pause to do it. Franchise experts understand (even to the point of sympathy) that other people simply cannot think the way they do and that others have to discover on their own things that the super-expert already knows or immediately discerns. Franchise experts display great patience with others, helping them to gain understanding from their own perspective, mentoring those who are developing their own expertise.

They create and own treasure maps. Franchise experts create and use

memory artifacts that are unique organizing schemes that enhance their performance. These treasure maps reinforce the structure of the expert's knowledge, and they refer to the treasure maps as others would call for manuals. As an example, one of three gurus at a weather forecasting facility maintained a file drawer in which he kept data (images, charts, and so forth) on severe weather events that he had miss-forecast, with notes on what he got wrong and why. This was a goldmine for training material. As a second example, a technical services manager at a utility had a treasure map (which he referred to as an

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"informal documentation record") covering the history of the utility's relation with the Public Services Commission, policies concerning record retention, and notes about power outage metrics and outage reports that explained how the Public Services Commission interpreted the metrics and how the utility itself understood them. This material would be a crucial resource for anyone who might adopt this expert's role. The information existed in only two places, however: the expert's hard drive and the expert's memory.

They lead, but usually by example. Franchise experts have the admiration

of their peers and subordinates, and they develop a knack for employing their special position in furtherance of their organization's mission. Others follow them in order to learn and get their help. But franchise experts do not spend much of their time explicitly developing leadership qualities. Although they occasionally might find themselves in management roles, they are not always comfortable there.

They engage in continuous learning. Franchise experts thirst for knowledge. They self-select into learning opportunities, both formal and informal. They are students of their craft, and they practice with zeal. They go to great efforts to avoid getting stale in their domain of expertise. They are among the first to sign up for training events and the last to leave, staying behind to ask instructors for clarifications. They view all of life as an opportunity for development and often bring seemingly unrelated activities and knowledge to bear in the workplace.

They think in detail about training to high proficiency. Franchise experts think about what it would take for someone else to achieve their level of proficiency. The technical services manager we mentioned earlier had thought in great depth about the various "people skills" and interpersonal strategic considerations required for anyone who would represent the utility before the Public Services Commission. Another of the franchise experts we encountered was a nuclear chemist at a power plant. He was expert at radiation and effluent monitoring. He maintained computer programs and the radiation counting system, and he supervised procedures to meet industry requirements and reports to the Nuclear Regulatory Commission. He had thought in remarkable detail about entry-level

requirements for his position (desired skills and abilities), training requirements to progress from the apprentice to journeyman level, and proficiency requirements for the journeyman and the expert.

All these factors defining franchise experts are certainly suggestive as things to consider in selection and in the promotion of aptitude, attitude, and motivation in order to make it easier to create new franchise experts and grow an institutional culture that rewards such attitudes.

Organizational Context

Some experts become extraordinary because of a personal choice to become a student of what interests them, but there are also organizational or situational factors. Franchise experts, by happenstance or by design,

- do not encounter organizational barriers (or they overcome or avoid them) and
- they receive some form of positive feedback or mentoring that encourages their success.

Achieving expertise is the purview of human resources departments. HR personnel have a keen interest in developing expertise through effective succession and workforce planning, training, information technology systems, and meaningful performance measurement approaches. We suspect that this is arguably true for organizations in all sectors of the economy.

However, the development of expertise often depends on chance and circumstance.[6] Many organizations have no institutionalized mentoring program. We know that the ability to effectively mentor is a skill set above and beyond that required for the domain expert.[16] Career development programs sometimes do not favor the development of technical expertise. And few incentives encourage the development of technical expertise. The labels *wizard* and *guru* are not necessarily signs of a rewarded status. The primary incentives that comprise many career development programs (including money) are not incentives that drive their self-development. Franchise experts, as we have pointed out, are motivated by the thrill of victory in solving problems or providing effective support to their teammates. Regrettably, improvisation might not only lack reward, it can actually be punished.

> Although many organizations know that they rely on experts to achieve their mission, they often don't realize the degree of dependence until those experts leave.

Another challenge in career development stems from the fact that organizational and business cultures tend to track the development of specific skills into leadership. But experts, particularly technical experts (who might become franchise experts) might have little interest in leadership positions. This situation presents a catch-22 for the utilities because technical expertise can be useful in roles typically performed by corporate leaders, such as negotiation.

Another challenge organizations face lies in being attuned to the extent of the mission impact of experts, particularly their senior and franchise experts. Although many organizations know that they rely on experts to achieve their mission, they often don't realize the degree of dependence until those experts leave, often through retirement that is encouraged by workforce policies. Robert Hoffman and Lewis Hanes referred to this as the "panic attack mode."[17]

Utilities representatives we have interviewed (including leadership and technical experts) insist that utilities want to support continuous learning and want to have the achievement of expertise as a corporate goal. This too, we suspect, is an avowed goal of countless organizations across sectors of the economy. Attaining the goal, however, can be challenged by the need to accomplish the immediate mission, the lack of incentives for mentoring, and career and organizational stovepipes.

We have begun to develop notions of what is it about the nature of the cognition that makes it take upwards of 25 years to achieve the franchise expert level of proficiency. For intelligent systems, the "pull and push" on this is the requirement for information technologies to be adaptive and resilient.[18] This requirement mandates the study of how franchise experts (and the one- and five-percenters) are able to adapt. It also raises the human-centering issue of information technology. Technology based on designer-centered design fails to amplify the human abilities to know and reason.[19] It challenges the worker with frustrations and brittleness issues, and it limits the

ability of workers to grow their expertise.

With regard to training and knowledge management, the pull and push is the payoff if we could reduce time-to-expertise from, say, 25 years to 20 years. Even junior experts are in a higher salary division, so any such time savings could have great practical significance. The window of risk, where loss of a particular expert could hurt the company's mission, could be reduced by accelerating the progression to extraordinary expertise.[1]

Specific achievements in the acceleration of expertise would be

- robust and efficient methods for identifying individuals who would be good candidates to receive training in how to be an effective mentor;
- application of knowledge capture and modeling tools to elicit and preserve the franchise experts' tacit knowledge, mental models, reasoning strategies, and treasure maps; and
- application of intelligent systems technologies to take that captured knowledge and generate training materials, exercises, and simulated decision problems.

To return to the origin of our term franchise experts, we note that sports clubs and professional organizations think of themselves in terms of building the future of their teams. Knowledge-based organizations might think about themselves in terms of nurturing the creation of franchise experts and building the organization around them. □

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