

Cultivating Perspectival Acuity: The Value and Cost of Integrating Theory, Craft, Research, and Practice

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ABSTRACT

This paper presents reflections on integrating theory, craft, research, and practice to improve the accuracy and resiliency of each. The reflections build toward a set of statements about the value and the cost of integrating theory, craft, research, and practice. Specifically, the authors offer the Privileged Work / Non-Privileged Work Framework and concept of cultivating Perspectival Acuity.

Keywords: research, consulting, Perspectival Acuity

1. INTRODUCTION

The theoretical cannot be made true without the tension of business and craft. The business cannot be made respectable without the tension of theory and craft. The craft cannot proceed beyond fancy without the tension of business and theory. We assume that because we have the separate words, business, theory, and craft, that they are actually separate activities. While one can be, at times, tended to more than the others, they are all always involved in practice, all of the time. Trying to relegate them to different realms in order to simplify the processing of each individually leads to distortions of each akin to those of a fun-house mirror. In these stratified realms, artifacts can be judged to be necessarily true, but validity is almost impossible to assess. [1]

This quote has been adhered to by the author for fifteen years. The concept has evolved to understand business as including both research and practice in industry and academia and has led to the creation of a knowledge development framework and a concept. This paper presents the Privileged Work / Non-Privileged Work framework and the concept of cultivating Perspectival Acuity. This framework and concept have evolved for investigating complex design/research challenges that require developing new constructs, methods, tools, and practices in order to address the design/research challenges. The cost of cultivating Perspectival Acuity is the tension that results from working between knowledge domains and perspectives simultaneously. Successfully managing this tension is essential, and the authors present strategies for doing so. This concept of cultivating Perspectival Acuity is reflected upon as a contemporary elaboration of common knowledge triangulation practices that have existed for quite a while in various professional domains. Lastly, a case is made that the need for Perspectival Acuity is growing as designers/researchers increasingly develop systems of systems for which there are no adequate mental models.

2. A FRAMEWORK AND A CONCEPT

Practical Integration of Theory, Craft, Research, and Practice

This paper documents a framework for integrating theory, craft, research, and practice that may be considered a *satisficing* solution [2]. As Herbert Simon might say, this approach suffices to satisfy the goal of integrating theory, craft, research, and practice. This approach to integrating theory, craft, research, and practice separates work activities into two classes, *Privileged Work* and *Non-Privileged Work*, and works between the two work classes in order to cultivate Perspectival Acuity. Each of these constructs is explained below.

Classifying Work

Work: For the purposes of this paper, work is defined as design and/or research activity with respect to a system of interest within a defined context.

Privileged Work: Privileged Work is purposefully kept unencumbered by the exigencies of people and organizations (i.e., politics, power dynamics, profit motives, recognition motives, etc.) because exigencies shift the goals from uncovering and/or operationalizing systemic validity/quality/truth/usefulness with respect to a system of interest to other goals that may or may not develop valid/quality/truthful/useful insights into the system of interest. For example, if a designer/researcher integrates two complex information systems, like building automation systems and automobile automation systems, treating this challenge as Privileged Work means that the scope of investigation, methods of analysis, timeline, findings, and direction of development are not influenced by external exigencies such as:

- what a funding agency or stakeholder will fund, or
- the available billable hours for the activity, or
- the methodological preferences of a superior, or
- what methods or concepts are trending, or
- what is most likely to lead to a publication or a patent.

All of these types of outside factors influence the direction and sequencing of work in the business of industry and the business of academia. Privileged Work is isolated from these exigencies (i.e., removes consideration of the work's potential commodity value from the goals, means, and logistics of developing it).

Privileged Work is executed because of intellectual passion and curiosity, or to serve a societal or individual aspiration or need. The value of Privileged Work is intrinsic in its production. It is developed just to see if it can be done, how it can be done, and if

it is useful. There are elements of play, creativity, joy, and experimentation in Privileged Work. Privileged Work is part of a search for Truth in the Enlightenment sense [3] (i.e., it is an inquiry into the nature of existence in order to advance human understanding) and it is therefore a service and a gift to society and not a commodity. Its direction and pace of development are beholden only to itself in the service of achieving a deep understanding of the system of interest and its context.

The potential downside to privileging work is that it can become a flight of fancy without purpose or value, divorced from reality. If, on the one hand, Privileged Work benefits from being protected from the limiting and distorting exigencies of life, the business of industry, and the business of academia, then on the other hand it potentially suffers from a lack of grounded-ness in real-world dynamics. A way to mitigate this weakness inherent in conducting Privileged Work is to functionally pair it with related but separate Non-Privileged Work.

Non-Privileged Work: Non-Privileged Work contrasts with Privileged Work by accommodating the political, economic, and personal exigencies of people and organizations (i.e., politics, power dynamics, profit motives, recognition motives, etc.) that benefit from the work. Non-Privileged Work is only beholden to goals of validity/quality/truth/usefulness to the extent that they can be met via a reasonable standard of care and they support achieving a viable project/product in order to achieve the political, financial, or personal goals stipulated in the work for the individual or organization performing the work, or the work's client. Non-Privileged Work always addresses the commodity value of the work. Non-Privileged Work constitutes the majority of work performed in the business of industry and the business of academia. Non-Privileged Work may provide formative and summative test cases for Privileged Work.

Perspectival Acuity Perspectival Acuity is the enhanced accuracy, trustworthiness, and usefulness of new knowledge and methods that are inherent by-products of requiring engagement of a knowledge domain or domains to occur simultaneously through the frames of reference (i.e., perspectives) of theory, craft, research, and practice. That Perspectival Acuity must be cultivated implies that improving Perspectival Acuity (and the resultant yield of competency and innovation) is itself an iterative, organic, and individual practice that is refined over time. Use of a Privileged Work / Non-Privileged Work framework is a rich heuristic milieu within which an individual can cultivate Perspectival Acuity. Engaging in Privileged Work encourages a designer/researcher to push knowledge and skill acquisition and mastery beyond merely what has a present-day commodity value and toward deep engagement with some knowledge domain of his/her expertise. At the same time, each of the Non-Privileged Work activities performed by the designer/researcher enhances proficiency (see Figure 1). Thus the Privileged Work and Non-Privileged Work symbiotically enhance each other and improve the knowledge and skills of the designer/researcher using the Privileged Work / Non-Privileged Work framework in a way that would not be possible if the designer/researcher were only engaging in either Privileged Work or Non-Privileged Work.

3. CULTIVATING PERSPECTIVAL ACUITY

Cultivation

Perspectival Acuity is a cultivated phenomenon. It takes resources, time, curiosity, and dedication to develop Privileged

Work, given that it likely does not have immediate commodity value and there may not be a community of similarly focused designers/researchers with whom to engage the topic. Furthermore, complementary Non-Privileged Work cannot be targeted unless a Privileged Work agenda is set. Also, it is not possible to engage in the targeted Non-Privileged Work unless the educational, experiential, and networking activities required to gain access to the targeted Non-Privileged Work are completed. Once Non-Privileged Work is secured, it must be maintained as competent industry and/or academic practice and research or it will be lost. In summary, the quality of Privileged Work and Non-Privileged Work (and their symbiosis) can be incrementally improved over time through cultivation.

Cultivating Triangulation of Perspectives in Research and Practice

The process of cultivating Perspectival Acuity is a process of triangulating between a set of useful perspectives (i.e., views onto a system of interest) in order to develop a more useful engagement of a system of interest than is possible from any one of the perspectives. The concept of triangulating between perspectives is well-established. In statistical analysis, validity of results is assessed using triangulation of methods and/or triangulation of data [5]. That is, achieving the same result by using different methods of analysis and/or different measures indicates that the results are likely valid. In systems engineering, iterative triangulation of methods for eliciting and prioritizing design requirements and potential design solutions is common, as represented by the spiral [6, 7] and V models [8] of project development, the Department of Defense Architecture Framework (DoDAF) [9] for specifying and assessing systems of systems, and the Unified Modeling Language (UML) [10] and Systems Modeling Language (SysML) [11] for rationally and methodically documenting system goals, use cases, requirements, and information flows using standard abstractions. In architecture and the social sciences, John Zeisel advocates a method of triangulation for developing environmental designs [12] and Robert Yin [13] specifies a method of triangulation for qualitative case study research. User experience design and information architecture also have sets of standard views onto information systems [14]. In human factors and cognitive psychology, cognitive work analysis [15], work domain analysis [16], and cognitive task analysis [17] also utilize triangulation of abstractions of systems information and assets in order to improve the safety, efficiency, and effectiveness of human-machine interfaces and work processes.

Typically, the perspectives, or views, are specified as sets of standard methodological and/or representational abstractions (e.g., equations, diagrams, etc.) that are generally useful for decomposing design/research challenges. Conversely, in the Privileged Work / Non-Privileged Work framework, the views that are developed are custom-selected/developed by the designer/researcher for a particular 'wicked' design/research challenge [4] (i.e. complex, potentially chaotic) and they co-evolve as part of cultivating Perspectival Acuity. That is, the designer/researcher intentionally grows and refines his/her own set of abstract views onto a system of interest as part of a Privileged Work/Non-Privileged Work workflow.

Perspectival Tension: The Cost of Perspective

The cost of Perspectival Acuity is a persistent tension that exists with respect to executing a Privileged Work / Non-Privileged Work agenda. This tension is due to a potentially problematic lack of alignment that occurs when clients, employers, and

colleagues do not know or understand an individual's Privileged Work and Non-Privileged Work agenda. Invariably, engaging theory, craft, research, and practice simultaneously entails many competing sets of priorities, schedules, goals, politics, and a steady stream of failure, trade-offs, risk management, and damage control. Progressing despite such dynamics can be stressful, exhausting, and requires an unflappable positive attitude along with a willingness to adapt in order to persist. All work in industry and academia entails some of these dynamics. Engaging in a Privileged Work / Non-Privileged Work framework increases exposure to these professional complications significantly.

Managing the Tension

There are four key concepts that are useful for managing the tension that results from cultivating Perspectival Acuity. The four key concepts are:

- *separation of concerns* [18],
- *Privileged Work/Non-Privileged Work framework*,
- *meeting people/organizations/projects where they are*,
- *communicating Privileged Work agendas with collaborators on Non-Privileged Work projects.*

Separation of Concerns and Functional Coupling of Modules:

Separation of concerns is a method of project development that organizes distinct functions in a system into functionally separate modules. Though the functions are modularized, there is typically some coupling between the modules (i.e., they are somewhat interdependent). Well-conceived and well-executed coupling can enhance the functionality of the system of interest as a whole, but modules do not have to be coupled. Similarly, it is possible to achieve integration of theory, craft, research, and practice through separation of concerns such that each Non-Privileged Work activity addresses aspects of the Privileged Work. The important point is that the Non-Privileged Work activities must relate in some clearly identifiable way to the Privileged Work (i.e., the privileged and Non-Privileged Work are coupled modules).

Placing Work Opportunities into a Privileged Work / Non-Privileged Work Framework:

Privileged Work and Non-Privileged Work include three sub-types: *applied research*, *evidence-based design/research*, and *basic best practice heuristics*. *Applied research* entails the rigorous application of established research methods to a work challenge in order to develop valid, accurate data that are useful for addressing the work challenge. This is the primary type of research conducted at universities and some corporations. *Evidence-based design* adds varying degrees of research rigor to standard best practice heuristics to better fit those best practice heuristics to a particular work challenge. Often the application of research methods in evidence-based design is prescriptive and the validity and/or representativeness of the data supporting the use of best practice heuristics are not validated. There is a wide range of rigor applied in evidence-based design [19]. *Best practice heuristics* are useful rules of thumb that deliver competent design solutions without the need for in-depth analysis of the context and/or design requirements. Using these sub-types to further sub-divide Privileged Work and Non-Privileged Work opportunities helps the designer/researcher to be selective and strategic about the likely contribution(s) that he/she can make with respect to a specific work opportunity, as well as what knowledge/skill acquisition/refinement benefit(s) that he/she may gain. Mapping these work sub-types also helps to manage coupling of Privileged Work and Non-Privileged Work activities (See Figure 1).

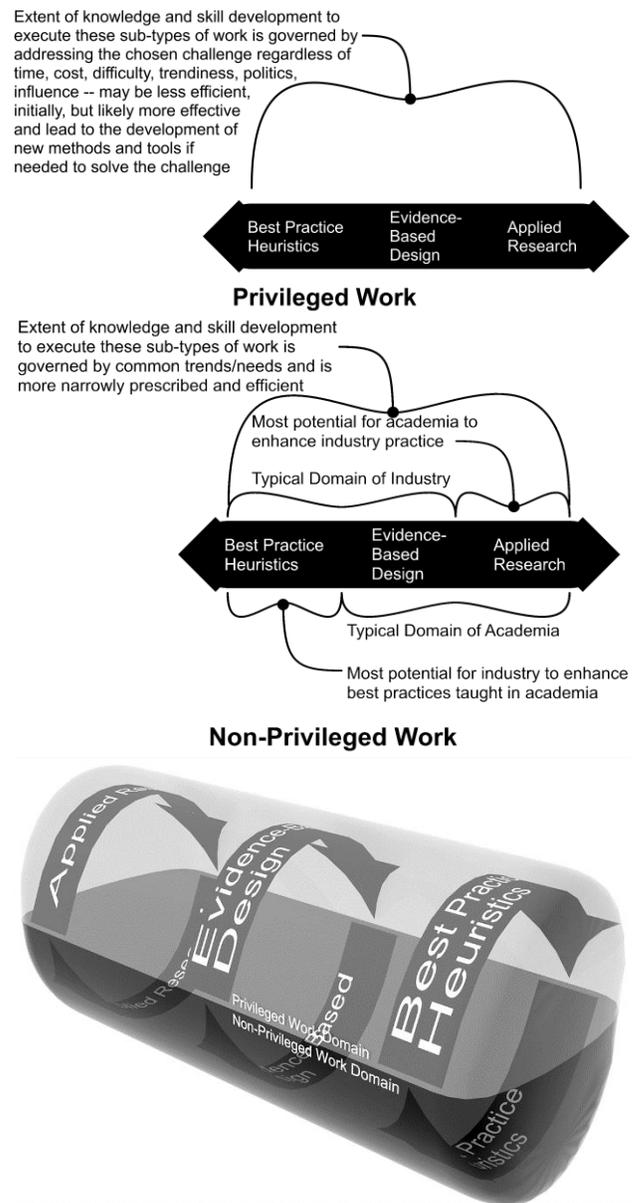


Figure 1: Classifying work opportunities to govern expectations about the likely contributions and benefits of engaging in a Privileged Work/Non-Privileged Work framework

Meeting People/Organizations/Opportunities

Where They Are: It is good practice to *meet people/organizations/opportunities where they are*. For example, a well-established tenet of designing and constructing sustainable buildings is that the client must already want a sustainable building. The designer is not going to convince the client to construct a sustainable building if the client does not want it. Even if the designer does convince a skeptical client to build a sustainable building, as soon as there are logistical issues, the sustainable features will be cut from the project and the effort is wasted. Therefore, the best practice for a firm practicing sustainable design is to find the clients who want to build sustainable buildings. This tenet is also espoused with respect to affecting organizational transformation of any kind (e.g., implementing a new database, website, safety protocol, etc.). There must be an organizational leader who champions the effort

or else it will not succeed or it will require more effort than it is feasible to invest in order to make it succeed.

This tenet also holds with respect to utilizing the Privileged Work / Non-Privileged Work framework. Attempting to execute Privileged Work while allowing it to be influenced by the exigencies of life, the business of industry, and the business of academia is likely to be stressful and unsuccessful. That is, the outcome of work that is developed in order to best address a set of technical/social goals and challenges cannot be made dependent upon other exigencies without compromising or at least unnecessarily complicating its successful development. Conversely, work that is intended to meet project exigencies (i.e., financial gain, recognition, and winning more work) cannot be executed efficiently and effectively if executing the work is limited by subservience to technical/social goals and challenges that do not respect the dynamics of political, economic, and personal goals. Thus separating concerns between Privileged and Non-Privileged Work meets each type of work where it is and respects its boundaries.

Communicate a Privileged Work Agenda to Collaborators on a Non-Privileged Work Project: If the development team for a Non-Privileged Work project is supportive, it is potentially beneficial for designers/researchers to share their respective Privileged Work/Non-Privileged Work agendas and to accommodate each other's agendas. It may be possible to accomplish the Non-Privileged Work while also ensuring that each designer's/researcher's Privileged Work agenda is fulfilled. However, with respect to the concept of meeting people, organizations, and opportunities where they are, if it seems that the development team is not receptive to sharing Privileged Work / Non-Privileged Work agendas, then it is best to respect the group dynamics.

4. CONCLUSION

So Right and So Wrong, but Useful Nonetheless

In conclusion, and with the benefit of experience and hindsight, the sentiments expressed in the quote at the start of this paper have turned out to be both very right and very wrong. On the one hand, it is in fact possible to integrate theory, craft, research, and practice in a symbiotic relationship and to develop deep and meaningful insights as a result of the integration. The basic premise of the quote is valid. On the other hand, Privileged Work remains somewhat detached from integration with practice for its own protection, so that the integrity of its search for Truth is not compromised by the exigencies of life, the business of industry, and the business of academia. Conversely, Non-Privileged Work remains somewhat detached from intrinsically motivated design/research so that it is able to serve the economic and political goals and needs of society, individuals, and organizations. Yet an integration of research and practice does occur --- *within the individual designer/researcher who simultaneously engages theory, craft, research, and practice* --- who implements a Privileged Work / Non-Privileged Work framework. The Perspectival Acuity of the individual designer/researcher is enhanced and the individual is better able to serve the needs of both Privileged and Non-Privileged Work.

This type of formal integration of theory, craft, research, and practice is becoming essential as designers/researchers increasingly develop mission-critical systems of systems for which they do not have adequate mental models [20]. In order to develop adequate mental models of emerging system types,

designers/researchers will have to privilege some work so that it is free of the exigencies of life, the business of industry, and the business of academia. For example, a near-term emerging design/research challenge may entail figuring out the extent and nature of human-human, human-hardware, human-software, hardware-software, and software-software interactions are between:

- an injured person wearing biometric devices in his/her clothing and as accessories, being rushed to a hospital in an ambulance;
- the ambulance with its own autonomous software agents responsively supporting the care provided by the Emergency Medical Technician (EMT) en route to the hospital;
- an array of biometric devices worn by the EMTs;
- the hospital's integrated databases, with information about the patient, the EMTs and all technical and social systems servicing the patient's needs now and over the course of the patient's assumed stay in the hospital;
- the information to be presented and requested on the patient and employee portals of the hospital's website throughout the duration of ambulance transport and patient care;
- the layers of security and regulatory compliance agents embedded in the system to protect the patient, the staff, the organization and society; and
- the hospital's semi-autonomous software agents accessing all of this data and anticipating the arrival of the patient as well as coordinating the needs of the patient upon arrival with the current logistics of staffing, facilities, and patient care within the hospital.

This example shows the complexity, large number of interactions, and mission-critical nature of emerging design/research challenges and why it is important to develop solutions that are not beholden to economic, political, or personal interests. At the same time, the emerging systems of systems must eventually become useful within the social, political, and economic context. The Privileged Work/Non-Privileged Work framework provides a way to engage such challenges.

Cultivating Designers/Researchers within Organizations Who Are Prepared for Emerging Design Challenges

To this point, the description of the Privileged Work / Non-Privileged Work framework and the concept of Perspectival Acuity have been discussed with respect to individual work. However, it is also possible for an organization to implement this framework and concept. For an organization, the use of this framework and concept can be applied endogenously and exogenously. In either case, the use of this framework and concept is most appropriate for an individual to engage emerging project types and design/research challenges for which there are not adequate mental models. Knowledge integration and dissemination within an organization is a separate, next step.

Endogenous Use of the Privileged Work / Non-Privileged Work Framework and Perspectival Acuity Concept

As described previously, the Perspectival Acuity that results from using the Privileged Work / Non-Privileged Work framework occurs within the individual – it is a singular practice. However, development of Perspectival Acuity within individuals within organizations can be an organization-sponsored activity and the organization can benefit from the development of such individuals. Doing so addresses the following organizational challenges: a) developing and maintaining knowledge domain

leadership, b) enhancing leadership succession initiatives, and c) preparing the organization for emerging industry challenges.

Exogenous Use of the Privileged Work / Non-Privileged Work Framework and Perspectival Acuity Concept Organizations that contribute to the theories, methods, tools, best practices, and standards development within their respective industries can use the Privileged Work / Non-Privileged Work framework and concept of Perspectival Acuity to organize contributions to professional practice and standards and to track how such contributions relate to the actual work and effectiveness of the organization.

Implementation within an Organization The Privileged Work / Non-Privileged Work framework and the concept of Perspectival Acuity may be implemented in an organization as part of a mentor-protégé program. In the mentoring process, protégés receive developmental coaching from subject matter experts (SMEs), who possess valuable knowledge about current best practices and who are active in industry. Mentoring is collaborative, with mentor(s) and protégé(s) developing learning partnerships. The ultimate goal of these partnerships is the development of effective leaders and new, useful knowledge. Figure 2 summarizes the objectives for a SME protégé mentoring program. Figure 3 provides an example of an SME protégé mentoring program. Figure 4 formalizes a process of organizational knowledge transfer.



Figure 2: Subject matter expert & protégé working group objectives

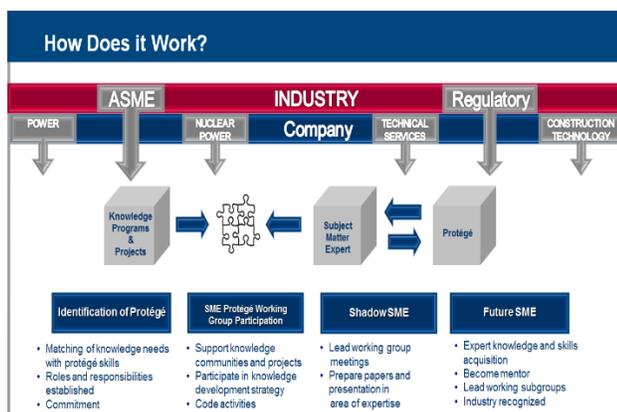


Figure 3: An example implementing an SME protégé mentoring program in the power industry

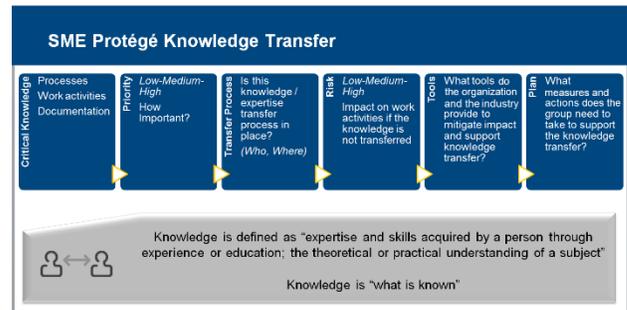


Figure 4: A template for SME protégé knowledge transfer

As presented in Figures 2, 3 and 4, the SME protégé mentoring program provides a platform for:

- long-term succession planning for the organization;
- accelerated learning by entry-level and mid-level employees through engagement with senior-level subject matter experts;
- development and maintenance of industry-specific knowledge for current and emerging challenges; and
- greatly assisting the current SMEs with their global knowledge management responsibilities.

These formalized partnerships mutually cultivate each partner's work on construct, method, tool, and/or practice development, as well as co-authoring papers and presentations, and co-attending technical meetings and/or conferences. Through these activities, SMEs and SME protégés collaborate to develop new knowledge and skills, review and revise existing knowledge and skills, and address topics relevant to current and emerging industry challenges. The partnerships collaborate one-on-one, however multiple protégés can be assigned to a specific SME, or multiple SMEs can be assigned to a specific protégé. When SME / Protégé collaboration leads to new knowledge/skill creation, the protégé presents his/her new knowledge/skill as a value creation topic at departmental meetings and training seminars within the organization. The overall result is a nurturing environment to develop both Privileged and Non-Privileged Work and a resultant yield of knowledge, skills, and competencies.

A Summative Image: Designers/Researchers as Set-Based Agents and Interpretive Technologies of Civilization

Given that designers/researchers often apply sets of logical filters (i.e., views) as components of best practice heuristics, evidence-based design, and applied research work sub-types, it is reasonable to consider designers/researchers as set-based reasoning agents [21]. However, there are design/research challenges wherein the use of standard sets of logical filters is not sufficient to address the design/research challenges – i.e., designers/researchers may be called upon to be more than just set-based reasoning agents. In such instances, creative processes (i.e., design thinking [4]) must be utilized. This is especially true when designing systems of systems for which there are not adequate mental models, such as 'wicked' problems [4]. That is, for emerging design/research challenges, the constructs, methods, tools, and practices needed to adequately and routinely address them may not exist yet, or may only partially exist [20], and therefore addressing the overall design/research challenge also entails innovating the constructs, methods, tools, and practices needed to successfully address the overall design/research challenge.

Given this, there is a substantial degree of interpretation and judgment involved in being a designer/researcher developing systems of interest for which there are not adequate mental

models. One could say that designers/researchers are themselves interpretive technologies [22] of civilization that birth new systems of systems, perspectives, constructs, methods, tools, and practices from a realm of potentiality into the realm of actuality (see Figure 5). Use of the Privileged Work / Non-Privileged Work framework to develop Perspectival Acuity is complementary to this need for designers/researchers to function as interpretive technologies of civilization because it requires the designers/researchers to develop knowledge and skills not only with respect to current standard design/research project types but also with respect to emerging challenges and needs. Use of this framework and concept can happen either solely at the individual level or it can be supported as an organizational work structure.

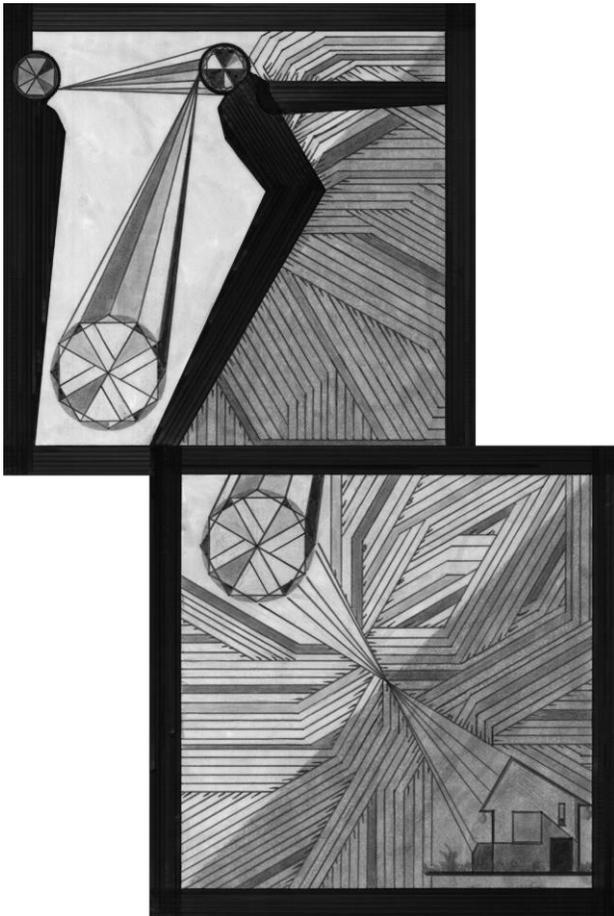


Figure 5: The role of the designer/researcher

From this perspective, the work of a masterful practitioner of integrating theory, craft, research, and practice in an age of complex and interactive systems of systems design/research challenges for which there are not adequate mental models is to deftly ground the work in worthwhile real-world needs and/or goals while simultaneously controlling the exposure of the work to the exigencies of life, the business of industry, and the business of academia. In this graphic, the designer/researcher engages needs/goals while simultaneously holding back exigencies, and chooses when and how to expose the work to the exigencies of real implementation. Through this careful and selective cultivation of the Privileged Work and a careful and selective cultivation of how and under what circumstances aspects of the Privileged Work transition into the realm of Non-Privileged Work, the designer/researcher functions as an interpretive technology of civilization and cultivates Perspectival Acuity.

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9. REFERENCES

- [1] J.C. Manganelli, "The Role of the Architect and a Description of the Forum for Design," in **Architecture as a Codifier of Belief Systems: The Minimal Dwelling, an Experiment Reconceptualizing the Home**, School of Architecture, Planning, and Landscape Architecture, Auburn University, Auburn, AL, USA, 2002. p.62. Excerpt Retrieved from: <https://datastructureformdesign.com/2013/05/07/the-workplay-anomaly-thoughts-on-architectural-practice/>
- [2] S. A. Herbert, **Administrative Behavior: a Study of Decision-Making Processes in Administrative Organization (1st ed.)**, New York: Macmillan, 1947.
- [3] J. F. Lyotard, **The Postmodern Condition: A Report on Knowledge**. Vol. 10, Minnesota: University of Minnesota Press, 1984.
- [4] R. Buchanan, "Wicked Problems in Design Thinking," **Design Issues**, 8, no. 2, (1992), pp. 5-21.
- [5] T. D. Jick, "Mixing Qualitative and Quantitative Methods: Triangulation in Action," **Administrative Science Quarterly**, 24, no. 4, (1979), pp. 602-611.
- [6] NASA, **NASA Systems Engineering Handbook**, Washington, D.C., 2007.
- [7] INCOSE, **INCOSE Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities Version 3.0**, C. Haskins, Ed., San Diego, CA: INCOSE, 2006.
- [8] D. M. Buede and W. D. Miller, **The Engineering Design of Systems: Models and Methods**. Hoboken, NJ: John Wiley & Sons, 2016.
- [9] Chief Information Officer, Department of Defense, **Department of Defense Architecture Framework Version 2.02**, 2010, Retrieved from: <http://dodcio.defense.gov/Library/DoD-Architecture-Framework/>
- [10] Object Management Group, **Unified Modeling Language, Version 2.5**, 2015. Retrieved from: <http://www.omg.org/spec/UML/2.5/>
- [11] Object Management Group, **Systems Modeling Language, Version 1.4**, 2015. Retrieved from: <http://www.omg.org/spec/SysML/1.4/>
- [12] J. Zeisel, **Inquiry by Design: Environment/Behavior/Neuroscience in Architecture, Interiors, Landscape and Planning**, New York: WW Norton & Co, 2006.
- [13] R. K. Yin, **Case Study Research Design and Methods (Applied Social Research Methods Series 5), Fourth Edition**, Thousand Oaks, CA: SAGE Publications, Inc., 2009.
- [14] A. Dix, J. Finlay, G. Abowd, R. Beale, **Human-Computer Interaction, Third Edition**, Essex, England, Pearson Education Limited, 2004.
- [15] K. J. Vicente, **Cognitive Work analysis: Toward Safe, Productive and Healthy Computer-Based Work**. Mahwah, NJ: Lawrence Erlbaum Associates, Inc., 1999.
- [16] N. Neelam, R. Hopcroft, and A. Moylan, **Work Domain Analysis: Theoretical Concepts and Methodology**, No. DSTO-TR-1665. Defence Science and Technology

Organisation Victoria (Australia) Air Operations Division, 2005.

- [17] J. Rasmussen. "A framework for cognitive task analysis in systems design," **Intelligent Support in Process Environments**, Berlin, Germany: Springer, 1986, pp. 175-196.
- [18] R. J. Mitchell, **Managing Complexity in Software Engineering**, IET. p. 5, 1990. ISBN 0863411711
- [19] K. Hamilton, "The four levels of evidence-based practice," **Healthcare Design**, November, 2003, pp. 18-26,
- [20] J. Manganelli, **CIAS-DM: A Model-Based, Human-Centered Architectural Modeling Method+ Tool**, Dissertation, 2013. Retrieved from:
http://tigerprints.clemson.edu/cgi/viewcontent.cgi?article=2250&context=all_dissertations
- [21] D.K. Sobek II, K. Durward, A. C. Ward, and J. K. Liker, "Toyota's Principles of Set-Based Concurrent Engineering," **MIT Sloan Management Review**, 40, no. 2, 1999, p. 67.
- [22] J J.C. Manganelli, "The Role of the Architect and a Description of the Forum for Design," in **Architecture as a Codifier of Belief Systems: The Minimal Dwelling, an Experiment Reconceptualizing the Home**, School of Architecture, Planning, and Landscape Architecture, Auburn University, Auburn, AL, USA, 2002. p.61.
Excerpt Retrieved from:
<https://datastructurefordesign.com/2013/01/07/technology-and-the-societal-domain/>