Continuing Professional Development of Engineering and Technology Adult Professional Learners

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Over 60% of the adult professional learners participating in continuing graduate professional development through the Purdue University's Center for Professional Studies in Technology and Applied Research (ProSTAR) are engineering and/or technology Bachelor degree holders. To offer successful continuing professional development programs to engineering and technologist professional learners, first requires an in-depth understanding of these target audiences.

In any new successful endeavor, whether it is product/process design or making a business contact to determine educational needs of adult professional learners, the first step is to determine basic needs or requirements of the target audience; in this scenario, the focus is adult professional learners and their respective businesses and industries.

In offering graduate education to adult professional engineering and technology learners we frequently assume one of three basic curriculum positions: (1) offer an existing program, (2) offer a curriculum permutation of existing courses, or (3) offer a permutation of existing and customized courses as deemed required by the end recipient (student or organization).

This paper examines and extends a most recently evolved study that provides insight into the target engineering and technologist adult professional learner educational premise. This paper builds on a recently published academic study by Land[1] that reports the position titles of hired graduates from engineering and technology, into business/industry positions. The Land study, enhanced by an understanding of where in the product/process life-cycle these titles are employed, and therefore what function each title performs, provides valuable insight into the continuing professional development needs of engineering and technology adult professional learners.

In the recent Land study, predominate titles assigned to technologists and engineering Bachelor of Science graduates were reported. The study received responses from nearly 200 business and industry technology-oriented companies. The Land study reflected, while there were titles assigned to both; the titles of design engineer, senior engineer and engineer were predominately assigned to engineering graduates. This, while the titles of engineering technologist, technologist, engineering technician and technician were predominantly reserved for technologists; i.e., BS Engineering Technology (BSET) graduates.

The findings of the Land study validate the experience of many in business and industry. The natural derivation of this previous Land study is to enhance and build on our understanding of the identified titles for each; the technologist and the engineer. Subsequently, the next logical step is a better understanding of the theory to practice curriculum continuum we offer to our working adult professional learners (students).

Understanding the curriculum continuum in business and industry is critical to providing a targeted and relevant course delivery to adult professional learners pursuing a graduate degree through our professional studies administrative organizations.

Basics of requirements identification –

Defining the requirements (needs) means being able to identify and manage what work is required to be performed. In basic terminology, this process is termed requirements identification as part of the overall requirements management process.

The requirements management process involves five steps[4,5]:

- Identification
- Analysis
- Allocation
- Verification
- Traceability

Identification is the only step required to be expanded on for this paper. This step provides the backdrop for why we need to better understand the mapping of titles to roles across the product life-cycle.

Requirements identification is the process of collecting stated and derived requirements from both internal and external sources. External documentation that provides a source for program stated and derived requirements includes the customer supplied description of what is needed (this may come in the form of a conversation or a more formal request for proposal). Internally, even though the customer never asked for a specific requirement, a continuing professional development administrative organization may place requirements on themselves to produce what is determine to be a quality product/curriculum. This, therefore, is considered an internal requirement, meaning, it came from one of their internal people versus from the external customer (adult professional learner/business).

An explicitly stated requirement, then, is one that is stated directly by the customer. For example, “we need a course in operating system design using multiple processors” In this case, the two stated requirements are: (1) operating system design, and (2) multiple processors. As a continuing professional development administrative organization, it is recognized there exists other prerequisite courses required to gain a full understanding and appreciation for what was explicitly stated as educational requirements.

These other courses are termed “derived requirements.” They are derived, because the customer did not explicitly ask for them, but they are required to provide the customer what they actually did ask for.

Defining the requirements, then, for adult professional learners in engineering and technology requires a basic understanding of what titles they possess, roles they assume in a business/industrial setting, and, how those many roles map to the product life-cycle of the business/industry.

The Land study (Land, 2012) –

The essence of studies and papers related to defining and differentiating the role of the technologist rests unconsciously on a lack of understanding of the roles played in the overall design, development and implementation of the product life-cycle; although few recognize it as such. This lack of understanding has contributed to a lack of understanding and respect for the differentiated roles, and specifically the role of the technologist. Land points out “…this lack of distinction has led to a number of persistent problems. Among them has been an inability of engineering technology programs to define themselves to potential students and their parents… (p. 33)”

The Land study accurately defined and differentiated the many business and industry titles of both technologists (defined as BS ET graduates) and engineers (defined as BS Eng. graduates). Land points out “…the perennial debate among engineering and engineering technology educators has been where bachelorette engineering technology (ET) graduates fit within the spectrum of engineering and technical careers.” To this end, the Land study was instrumental in validating what many in business and industry already suspected; that being, the key difference between technologists and engineers resides in the education both receive (application versus theory) and their most applicable subsequent roles and titles on entering the workforce. Importantly, and a required follow-on, is a better understanding of each cohort’s contributions to the engineering processes attendant to the product life-cycle.

Technologists have an applied natural education-based applicability of their talents to the already established and well understood product life-cycle. Engineering as a theory-based rigorous discipline, has been less supportive of a recognized applied subset of their research and theory-based engineering curriculum, and have been reluctant to share the title of engineer with their applied colleagues. To this end, engineering technology programs prevailed separate and as a natural applied evolution from engineering.

Expanding the Land study – defining the roles and their mapping

Figure 1.0 depicts the titles assigned to graduate technology and engineering majors mapped to the generally accepted product life-cycle model phases[2,3].

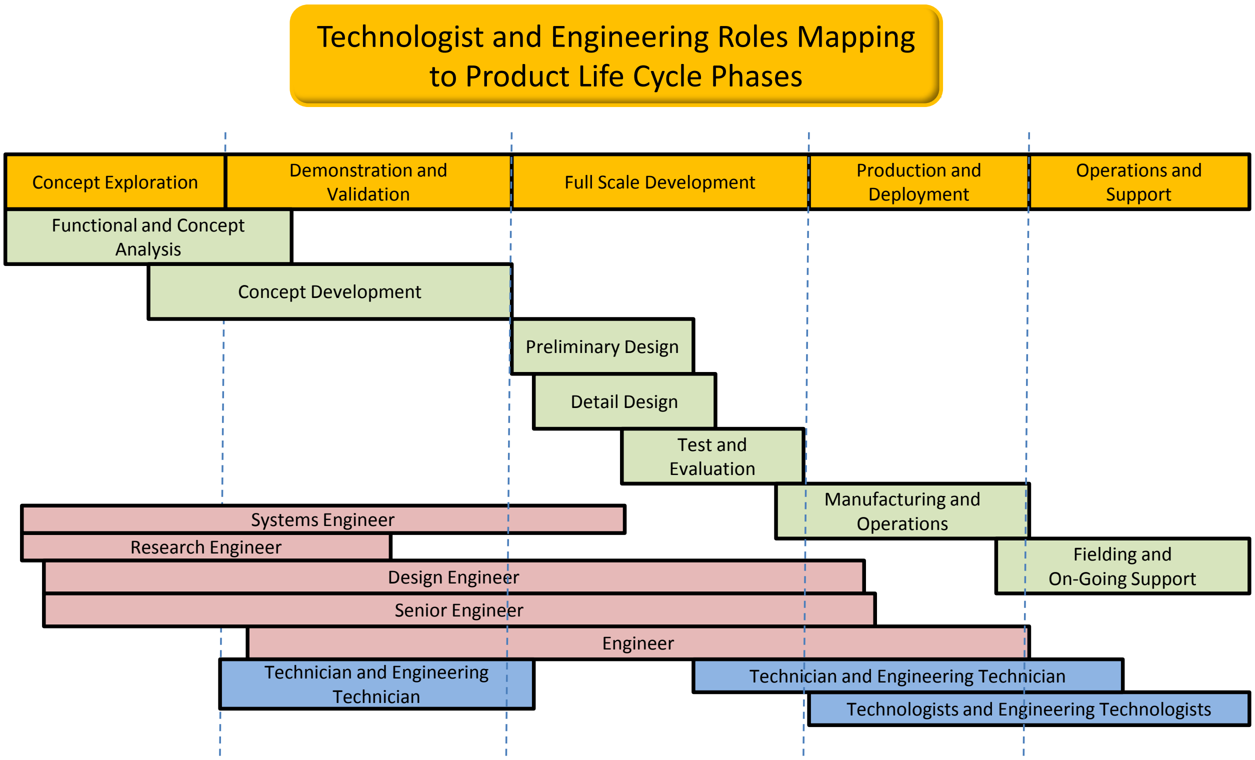

Figure 1.0 – Technologist and Engineering Titles/Roles Mapping to Product Life-Cycle Phases

At the macro view, there are five major phases to a product's life-cycle; concept exploration, demonstration and validation, full scale development, production and deployment, and, operations and support[6].

Concept exploration is that phase which identifies and evaluates alternative potential solutions. The primary activities of this phase are focused on determining the financial possibility and market opportunity of a given program's products or services. During this phase, front-end operations, systems and senior-level engineers are highly involved and active. The operations engineers are working to understand and translate the operational requirements (e.g., zero to sixty in ten seconds) in a manner which allows the systems and senior engineers the opportunity to conceive of the required component, sub-system and system elements for a successful platform system that ultimately will satisfy the requirements of the customer. This phase is front loaded with highly experienced and highly educated personnel.

During the demonstration and validation phase, the primary technologies, both hardware and software are essentially prototyped in a manner to verify and validate the original premise that the program's product or service can be produced in accordance with the customer's stated requirements. During this phase, a great deal of wire-wrapped hardware modules are created for a hardware system and less than fully developed software modules are evolved and integrated in a manner which reflects the functionality, speed, memory and other critical stated requirements. This phase requires a great deal of bench modeling (prototyping). To this end, it is quite natural to engage technician and engineering technicians. These individuals, defined to be a role most occupied with BSET graduates, are responsible for assembling and integrating the prototype models.

As the prototype is fleshed for risk, components, both hardware and software, are demonstrated to be feasible economically and technically. The demonstration and validation of the concept is moved into the full scale development phase. Full scale development is a massive ramp up of resources. It transitions the concept, as conceived and validated in the demonstration and validation phase, through a series of increasingly detailed process steps; preliminary design, detailed design, build, test and evaluation. The titles attendant to these process steps, are occupied predominately by engineering personnel. However, as the system design is moved towards build, test and integration, we see the titles once again occupied by technicians, engineering technicians, technologists and engineering technologists begin to materialize. This is evidenced by the type of applied work required for build, test and evaluation.

In the production and deployment phase, the objectives are "…(1) to establish a stable, efficient production and support base; and (2) to achieve operational capability that satisfies [the customer][2]…" this phase requires the continual testing of the deliverable product from component to sub-system to system. This phase, again, supports the roles most readily populated by technologists.

Operations and on-going support overlaps with the previous production and deployment phase. Its purpose is to ensure a stable and functioning deployed system. The roles predominantly employed during this phase, while not discussed at length in this paper, are test and field engineers. Both of these engineering roles may be occupied by either technologists or engineers.

The above is not singularly defined and used unanimously by all business and industry organizations involved in the product design, development and implementation through product life-cycle processes. The above model does however, provide a natural and required additional deeper perspective on the differentiation and understanding of the roles predominantly occupied by technologists and engineers. It also allows for a greater understanding of the engineering to applied engineering natural continuum for product design, development and implementation.

Applicability to continuing professional development of adult professional learners –

In reviewing the disciplines of the incoming adult professional learners to ProSTAR administered programs, from the below, over 60% are from majors originating in colleges of engineering and technology. To this end, it is imperative to fully understand titles/roles and mapping of those titles/roles to the respective business and industry from which they reside[7].

Agriculture % of Total	Education % of Total	Engineering % of Total	Liberal Arts % of Total	Science % of Total	Technology % of Total	Management % of Total	Health Sciences and Nursing % of Total
0.37%	1.30%	17.41%	17.04%	10.56%	42.78%	9.07%	1.30%

Figure 2.0 – Participant Originating Disciplines

The above provides insight into the engineering and technologist titles assigned to current adult professional learners, and how those titles and their attendant roles apply to the product/process life-cycle model. With this, continuing professional development administrative organizations can more readily begin to define the most applicable elements of the theory to practice curriculum continuum. Given this greater understanding, continuing professional development administrative organizations are more able to define the derived requirements of their target audience. And more applicably, are better able to suggest what may be stated course requirements as part of a proposed curriculum.

Areas for future thought –

The above maps the roles of the technologist and engineer to the life-cycle phases of product design, development, manufacturing and support. It should come as no surprise the technologist typically is involved in the early demonstration and validation phase and then again in unit testing (during design) to system fielding (through manufacturing). Previous work validates this model. This is not to say technologists don't assume other roles, it simply demonstrates how titles and attendant roles relate to commonly accepted life-cycle phases.

Given engineering technology is a natural extension (applied) of engineering; which few would likely debate, it is not suggested technologists are engineers, it is simply suggested they are a natural extension of engineering; the applied portion. This implies technologists have an overlapping educational curriculum extending to an applied component. The above role mapping reflects this reality.

The engineering and technologist assigned titles upon graduation, roles played by each, and, their mapping to the product/process life-cycle model, provides insight into the curriculum continuum required in business and industry.

Understanding the curriculum continuum in business and industry is critical to providing a targeted and applicable course delivery to adult professional learners pursuing a graduate degree through continuing professional studies administrative organizations[8,9,10].

Without much visualization, tremendous synergy would appear to come from a unified engineering and technology approach where a basic underlying agreement is the research, design, development, test and integration product life-cycle model understanding. In this manner, technologist would be provided with an overlap of engineering knowledge and then the subsequent applied knowledge required to perform in their respective life-cycle phases of the product life-cycle model. This greater level of understanding provides valuable insight into curriculum applicability.

In the final analysis, it can readily be argued technology graduates are in fact involved in the application of engineering principles; their many predominantly assumed roles are clearly defined throughout the product life-cycle model. With an understanding of assumed roles and the mapping of those roles to the product/process life-cycle model, continuing professional development administrative organizations can focus on moving forward in a positive manner to integrate educational foundations to better serve these much needed, required and highly sought after technical professionals.

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