CASE REPORT

The Ecosystem of Business Education in a Technology Environment

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Abstract: The Knowledge Economy is the environment within which we live and work today. It impacts all work, both within organizations and the emerging workforce. The Knowledge Economy relies on workers’ expertise (individual knowledge) and the informed integration of this knowledge to move an organization in a positive direction. This article describes a Knowledge Economy program (Project-based Internships) that enables organizations and new workforce members to experience and grasp the importance of knowledge work in sustaining and growing organizations. This is especially applicable to the technology domain as the founders in this area are focused on their individual knowledge of science and technology. They often need to build sustainable organizations with knowledge work to deliver and sustain their expert inventions and/or discoveries.

Knowledge work has two distinct attributes that define its orientation and operation. Knowledge workers are autonomous in their work and they are asset-thinkers, meaning that all work is focused on a result, which will create value for an organization. Within these two attributes, knowledge workers also must recognize the difference between quality and quantity, use project structures, and continuously evaluate for learning and innovation. Our current education system does not recognize the individual knowledge perspective in shaping students’ experiences. Project-based work is structured to empower and enable students’ experiences to be knowledge work to foster this thinking and its best practices and to create the environment that supports knowledge work within the organizations that the knowledge worker serves.

Various current-day methodologies are built into the structured project work, such as The Lean Startup, the recognition of invisible capital and growth mindsets, building knowledge work capabilities, and, finally, building an organizational environment in which success will thrive.

Keywords: Culture, knowledge work, knowledge environment, mindsets, communication, collaboration, knowledge work expertise, data, information, knowledge, wisdom, action plan, experiential learning.

1. INTRODUCTION: THE KNOWLEDGE ECONOMY

The world of work in the 21st century is different. As Peter Drucker [1] summarizes in Post-Capitalist Society, the knowledge economy requires knowledge workers to best fulfill their work roles by developing skills of autonomy and asset thinking, using a project focus. Drucker further includes the ability to qualify and quantify results and to learn continuously. Additionally, the 2016 World Economic Forum [2] leaders in Davos, Switzerland call for the 21st century workforce to enable themselves with critical thinking and decision-making skills. Autonomy, asset thinking, projects, critical thinking and decision-making change the nature of work and organizations that employ knowledge workers.
As a background context, it has been recognized that our education systems are oriented to provide skills needed for work in the industrial revolution. In this timeframe, workers had to follow directions with complete discipline. Thinking was certainly not a priority; in fact, thinking was discouraged. In contrast, in today’s 21st century environment, thinking must be a priority.

Russell Ackoff and Daniel Greenberg [3] present an updated concept of education, teaching, and learning for 21st century needs. As authors of Turning Learning Right Side Up, Ackoff and Greenberg point out that our current education systems are completely ineffective. The Latin verb, *educere*, from which our word education comes, means to draw out from within. Our education systems try to put in, based on pre-defined curriculum and teachers talking to students. There is no allowance for students’ internal inquisitiveness to define and then embrace what is important to them. We do not draw out, we put in.

Today’s knowledge worker must draw out from himself or herself. Their knowledge worker skills make it possible for knowledge workers to construct relevant questions that direct data and information searches to inform decisions for solving complex problems. Today’s digital and automation capabilities enable unlimited data and information searches of both structured and unstructured data to inform decision-making. This scenario encourages worker autonomy, which sets the stage for the drawing out process [4].

The asset thinking characteristic means that all work is done in the context of a result that will be of asset value to an organization. Results-oriented work is contrasted with activity-based work that is done with a volume orientation. Results-oriented work is done with a specific, measurable result in mind that can be translated into an asset for the organization.

An education ecosystem that includes company and student needs evolves in this scenario. Considering the needs of early-stage technology companies to build business infrastructures that enable their growth, employing trained and competent knowledge workers is essential to the growth of these companies. The business infrastructure that these knowledge workers create supplements the unique ideas of biotechnology founders. Even though these founders have great and significant scientific ideas, they need help to develop a business infrastructure necessary to implement these ideas within a market structure, ensuring regulatory compliance, customer satisfaction, and revenue generation models and schemes for a sustainable enterprise [5].

Considering the needs of students to build their knowledge worker skills of autonomy and asset value in the workplace, working within these early-stage companies gives them relevant and significant experiences, *i.e.*, opportunities, to build their 21st century skill-base. That skill-base, in turn, helps the companies integrate the knowledge worker skills into their current environments for a culture of performance and collaboration [6].

2. PROJECT-BASED INTERNSHIPS

The need for 21st century business education, partnered with the needs of early-stage technology companies, creates a “perfect storm” for meaningful learning, both for the emerging workforce of knowledge workers and for company growth and sustainability. Project-based internships provide the opportunity for companies to identify functional, business needs in a project definition. They also allow Knowledge Worker Project Associates (KWPA) (students or recent graduates) to build the projects in a way that enables their autonomy and asset thinking mindsets for growth (Ackoff, Addison, Magidson) [7].

Project-Based Internships (PBIs) are uniquely positioned to help early-stage companies build the infrastructure needed for establishing and sustaining their businesses. PBIs are structured forms of work that create new value for the early-stage company. This new value includes products, services, and/or infrastructure development, as well as results-oriented learning for the company.
Templates, building stakeholdership, data collection, and metrics are key elements of the project work.

PBIs engage a KWPA in fulfilling a company need through relevant planning, data and information identification, collection, and analysis, as well as the testing of optional solutions regarding their supply and demand scenarios. (Fig. 1) presents a knowledge pyramid that describes the development of an action plan that is based on the analysis of relevant data into information, which is analyzed into knowledge, relates to a business project, which ultimately defines the wisdom to create a plan of action.

PBIs follow a startup approach, created by Eric Reis in The Lean Startup [8]. Product developers define a minimum viable product, test the concept with likely users, get feedback, and then revise the product according to that feedback. This process is done in several sequences until the final product is sure to be exactly what a user will find valuable. Data design (asking the right questions), collection, and analysis are key elements of the lean startup method. Implementing this methodology equates to very tangible experiential learning, benefitting the KWPA and the sponsoring company.

The lean startup methodology of product or business development creates an environment using data and information structures along with supply/demand scenarios. Ensured success is represented when the point of equilibrium is reached. PBIs adhere to and maximize these structures for best project results.

As biotechnology is a field that requires the identification of research questions, relevant data, and their collection and analysis in order to build a successful product, the field provides a great environment for sponsoring PBIs. PBIs implemented through the lean startup methodology using autonomy and asset thinking build business infrastructure in a way that is parallel to biotechnology scientific processes.

2.1. PBI Structure

A company, emerging or established, defines a project need with an objective and a desired result. A group of KWPAs scans the inventory of projects and selects a few, prioritizes them based on their interest in the company and the project, and then interviews with the company to test for a match. Once matched to a company, the KWPA begins to define all of the steps necessary to complete the project in the timeframe required. Table 1 describes the project planning steps.

As is indicated within the project template, a timeline for completing milestones and the tasks required for each milestone are created. Work is planned backward from the final due date to ensure that time is balanced effectively to meet the desired result of the project. All work is results-oriented, not activity based, applying a metric to each implementation step of the project.

2.2. Benefits/Impact Summary

PBIs are designed to create new value for the sponsoring company. (Table 2) [9] is a summary of the benefits and impact that will create that new value. Supervisors review the KWPA’s assessment, adding or deleting to confirm value created from the company perspective.

2.3. Project Guidebook

At the end of each project, KWPAs document the work that they have done for each company,
### Table 1. Project template.

<table>
<thead>
<tr>
<th></th>
<th>Description of the issue, need or work to be achieved, including the international aspect of your project</th>
<th>Relevant questions and data needed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project name, description, and purpose</strong></td>
<td>Who will be the critical path contacts in this project work?</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Company and people involved</strong></td>
<td>Goal to be achieved</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Result expected</strong></td>
<td>Description of the current situation related to the project area of focus</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Business - Current state</strong></td>
<td>Milestones to achieve; final goal to be achieved; benefits/impact to be achieved (Check Benefits/Impact Summary.)</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Gap to be filled</strong></td>
<td>Schedule of work and milestone achievement target dates</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Timeframe</strong></td>
<td>Description of the high-level milestones and work plan steps for each milestone toward project completion and the relevant timeline and metric to measure your success for each work plan step.</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Milestones for completing results expected; Implementation steps, dates, tracking &amp; metrics</strong></td>
<td>Identification of all who can impact the result of your project work</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Stakeholders to be engaged beyond those involved</strong></td>
<td>What do you need to complete this project work? How much time do you need to spend with each of these resources?</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Resources needed and time estimate for each resource</strong></td>
<td>What resources are available and what needs to be obtained in order to successfully complete this project work?</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Resources available and gap to fill</strong></td>
<td>Any other needs or variables to be considered in completing this project work</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Other comments</strong></td>
<td>Agreement on communication mode and plan, meeting plans with supervisor</td>
<td>Relevant questions and data needed</td>
</tr>
<tr>
<td><strong>Meeting schedule and agenda for meetings</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Analysis of value created.

<table>
<thead>
<tr>
<th>Benefit/Impact</th>
<th>Company Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time Savings</td>
<td>What aspect of your work made your sponsoring organization more time efficient?</td>
</tr>
<tr>
<td>Cost Savings</td>
<td>What aspect of your work made your sponsoring organization more cost effective?</td>
</tr>
<tr>
<td>Revenue Generated</td>
<td>Did any aspect of your work generate new revenue?</td>
</tr>
<tr>
<td>New Business Concepts</td>
<td>Did you uncover any new business concepts through customer insights, market awareness, trend analysis, etc.?</td>
</tr>
<tr>
<td>New Business Pipeline</td>
<td>Did you add any new customers to the business pipeline?</td>
</tr>
<tr>
<td>Supporting Endeavors</td>
<td>Were you able to institute any new endeavors that would support another function?</td>
</tr>
<tr>
<td>Infrastructure Development</td>
<td>Did you develop any new segments of infrastructure that make the organization more efficient or more effective?</td>
</tr>
</tbody>
</table>

along with directives on how to continue the work, as needed. The final project guidebook includes:

**2.3.1. Project Description**

Includes the project objective and description of needs.
2.3.2. **Project Outcomes**

Includes a summary of value intended and value created.

2.3.3. **Users/Audience to Benefit from this Guidebook**

Describes who will most likely benefit from the information included in this guidebook.

2.3.4. **“How-to” Topics**

Includes a description of how another can benefit from the work that you have achieved, such as a description of how to update a database, work through a training course, continue a social media campaign as designed by you, etc.

2.3.5. **Conclusion**

Summary of individual and company learnings:

Project work is generally planned for about 4 to 6 months, depending on the complexity and volume of the desired result. A large percentage of KWPAs, between 80% and 95%, are offered more project work or full-time employment at the end of their projects.

2.4. **Boot Camp for Developing Knowledge Worker Skills**

During the project timeframe, KWPAs also attend a Boot Camp where basic management/knowledge work skills are presented for use within the project work. Boot Camp topics include sequential project skills, research questioning, relevant data collection and analysis, communication structures, timelines, metrics, asset thinking, and industry/self analysis, as described in the following sections:

2.4.1. **Creating an Entrepreneurial Mindset**

21st century work in the knowledge economy requires that we become knowledge workers who are autonomous and assets in startup and organizational environments. All companies need to grow in order to sustain themselves in the knowledge economy. This economy is full of uncertainty as there is no end to the availability of data and information, connectivity, mobility, generation-specific contributions, and globalization in general. As unlimited opportunities arise, complexity increases. This requires a mindset that can navigate this complexity with critical thinking skills, complex problem solving abilities, stakeholdership management, and the capacity to seek and see opportunities to innovate continuously. The Lean Startup methodology builds this entrepreneurial mindset to create new products and services in uncertain environments, eliminate waste in materials, time and efforts, and maximize stakeholders’ passion, energy, and commitment for continuous value creation. Lean Startup methods include validated learning, a build-measure-learn cycle, innovation accounting, and adaptive organizations. This module helps KWPAs to develop the entrepreneurial mindset to effectively navigate the 21st century knowledge economy.

2.4.2. **A Project Approach**

This module presents the concept of project work (Ackoff). It defines the work of a project as a knowledge work initiative that builds the autonomy and asset thinking required in the knowledge economy. The following knowledge work skills are introduced and used to define the work and, then, to do the work, including context building, communication, time management, decision-making, quality and quantity determinations, metrics for evaluation and learning, networking for stakeholdership, team collaboration, finding opportunities for innovation, and project systems. Project components include a project objective, a desire result, a description of current state, an analysis of the gap to be filled, stakeholders, milestones and metrics to measure them, implementation steps to achieve each milestone, a timeline for each implementation step and milestone, an evaluation of current and needed resources, and note of special circumstances that might impact the project.

2.4.3. **Communication Frames, Network, and Mentors**

This module explores a communications framework (Jensen) [10] to facilitate effective
communication, considering the diverse perspectives of listeners as stakeholders. It also helps participants identify their invisible capital (Raab), along with their network (Garber) [11] of connections and mentors. A system for adding to this network, as well as for maintaining it, is explored for best knowledge work support.

2.4.4. Timelines and Metrics

Timeline management is built into the communications framework to balance relevant and successful outcomes in an expected timeframe. Also, selling skills are included as a practical application of effective communication. Relevant metrics for each milestone on a timeline are identified.

2.4.5. Industries, Their Personalities and Project You

This module helps KWPAs understand the world of commerce and how each operates with a distinct perspective (Kennedy and Deal) [12]. Characteristics of various industries, markets, and customers are explored in order to establish context for a specific enterprise. Also, individuals’ characteristics and value structures (Hofstede) [13] are identified to maximize strengths, interests, and preferred mode of work for greatest productivity.

2.4.6. You as an Asset: Building Your Brand

This module helps KWPAs determine how to build the system by which they will be considered an asset to the specific organization in which they will be working.

3. KNOWLEDGE WORK ENABLERS

Knowledge work is essential in the 21st century. Enabling this work in any organization is dependent upon three characteristics that create a platform for success. This platform allows projects to be completed as knowledge work. Individual and company platforms are essential, as described below:

3.1. Individual Growth Mindsets

Dweck [14] in Mindset explains the value of a “growth” mindset as opposed to a status quo or limiting mindset. Ms. Dweck identifies the asset thinking value of seeking options through the learning achieved through a “growth” mindset, as well as the limitations of a “can’t do” mindset. She also describes how to migrate a “can’t do” mindset to a “growth” mindset through the use of personas to help restructure behaviors and decision-making. This “growth” or learning mindset is essential to project work and the environment to reinforce autonomous and asset thinking. This mindset enables continuous growth.

3.2. Success and Luck

Frank [15] in Success and Luck discusses the components of an individual’s success, citing the advantages and the general good luck of chance happenings in orchestrating a future advantage. The good luck of chance happenings is contrasted with the myth of meritocracy. These chance happenings can be intentionally built into an environment of an organization to affect future successes. Creating the environment of success, a lucky environment, happens through the availability of data and information for implementing lean startup methods, reinforcement of autonomous and asset thinking, knowledge worker growth mindsets, and best practices of collaborative and integrated work.

3.3. Invisible Capital

Raab [16] in Invisible Capital discusses a tremendous resource that individuals often overlook. This type of capital is inherent in everyone, it just needs to be recognized for its value. Who do you know? What and whom do those people know? What are your hobbies and/or special interests? What transferrable skills do these special interests afford you? What experiences have you had, especially ones that you would like to forget? What reflections do you have on any and all experiences? The list of queries could go on and on. All that you have done or been exposed to during your entire life makes up your invisible capital. We all bring this capital to our current experiences, challenges, and problem solving, whether for ourselves or our organizations.
4. COMPANY EXAMPLES

Company examples follow to give an idea of how early-stage biotechnology firms have used PBIs to complement their scientific discoveries. Project work fills the gap between an exceptional idea and the viability of that idea to a targeted market and to spark relevant investor interest.

A biotechnology startup has a colon/rectal test that detects cancer in its earliest stages. The company founders needed a marketing strategy and plan, data collection and analysis on market needs, and a survey of investor needs.

A mammography services startup provides uniquely detailed mammography testing. The company had a need for data analysis of design components, competitive analysis, website design, an inventory of potential partners, and investor profiles.

A Hepatitis B research foundation is initiating an ideal incubator, ID Leap to support doctors and other medical professionals in their business initiatives for new products and services. This initiative needed a business plan, market research, and a budget for moving forward. An analysis of investor needs was also needed in order to present ID Leap in a favorable light.

A pharmacogenomics firm provides genetic testing for individual patients’ drug compatibility. This firm needed connections to Chinese labs to partner for product expansion into the Chinese market.

CONCLUSION

PBIs are a novel approach to experiential learning due to their collaborative and integrated nature. They intentionally draw out of individuals, both as KWPAs and company founders, their invisible capital and growth mindsets to solve problems together. There is an understood complementary nature to this collaboration since the founders of the early-stage biotechnology companies are expert in their scientific knowledge and expertise and the KWPAs bring the business side of company development to the forefront to build out businesses around their exceptional scientific ideas. Also, a peripheral, but a very significant factor is the integration of knowledge work within the current company.

These experiences add value in multiple ways:

- Project work – builds company infrastructure so that a company can scale for sustainability.
- KWPA growth mindset – encourages and reinforces a knowledge work mindset for considering “can dos”, as opposed to “can’t dos”, a learning mindset of options for a path forward.
- Jobs created – Sustaining companies are great hotbeds for needing knowledge workers.
- Company member’s growth mindset – encourages and reinforces a knowledge work mindset for considering “can dos,” as opposed to “can’t dos,” a learning mindset of options for a path forward within the company.
- Gig/contractor workforce competent in project work for short-term needs – builds knowledge worker skills for providing contracted/gig economy work to growth companies on an as-needed basis.

Knowledge work is not a mode of the future. It is a requirement for building a competitive and sustaining enterprise.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are the basis of this research.

CONSENT FOR PUBLICATION

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REFERENCES