Creationeering®: A Systematic, Integrated Science-Engineering-Business Paradigm and Educational Program

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Abstract

The creationeering® paradigm offers a suggested path for an individual to progress from scientific inquiry through engineering development to a final product, and this paper introduces the associated K–PhD educational framework. This systematic approach is motivated by the Dominion Mandate in Genesis 1:26–28, whereby God calls mankind to rule and reign over the Earth. Our current K–12, undergraduate, and graduate-level learning environments are not integrated for engineering, causing a lack of knowledge in our culture of people who do not fully understand the engineering process. The systems engineering steps are defined by the following: design, analysis/synthesis, procurement/making, logistics, assembly, performance/function, sustainability, and death/recycling. The business aspects include the following: human personnel, finances, legal, sales/marketing, and management. The scientific method is employed for prototyping within the engineering "analysis/synthesis" step. The K–12 creationeering educational program is broken down into four units for K–2, 3–6, 7–9, and 10–12 grades. An example of engineering a car crash is used to illustrate the points. The undergraduate creationeering curriculum maps each course with each engineering step to provide the student understanding of each class fitting into the degree plan. The Liberty University undergraduate ABET-accredited Mechanical Engineering Degree Program is used to illustrate the point. The graduate creationeering focus is on developing analysis/synthesis tools for prototyping. Although pieces of this holistic paradigm have been used in educational engineering programs, particularly at Liberty University, a comprehensive K–PhD program like the creationeering paradigm proposed herein has not. In essence, creationeering states: Create the prototype using the scientific method! Create the engineered product! Create the Intellectual Property! Create the business! Then we can serve mankind with the business to meet humankind's needs.

Simple Summary

Creationeering® is a comprehensive educational and professional framework that merges systems engineering with entrepreneurial business principles. Rooted in a Biblical worldview, the paradigm seeks to bridge the gap between scientific discovery and the delivery of finished products to consumers. The author outlines an integrated K–PhD curriculum that teaches students how to navigate eight specific engineering stages (design, analysis, procurement, logistics, assembly, performance, sustainability, and death/recycling) alongside five core business functions (finance, marketing, management, personnel, and legal). Using the automotive industry as a primary case study, Horstemeyer explains how this model prepares individuals to create intellectual property and manage technical corporations from a Biblical paradigm. Ultimately, the educational engineering program aims to provide a holistic perspective currently missing from traditional STEM education by emphasizing the practical "creation" of the world.

Introduction

Science, design, engineering, and entrepreneurship are often considered separate disciplines. We have programs at universities that train students in these different areas where Bachelor's, Master's, and even Doctoral degrees can be earned, developed in response to industry needs. The focused training of students in each of the distinct disciplines of science, design, engineering, and entrepreneurship leads to an individual's narrow paradigm when considering aspects of the other disciplines. Currently, there is no holistic perspective that integrates these notions, although the Kern Entrepreneurial Engineering Network (KEEN) (2023) has been making progress to that end since 2005.

Since there is also confusion about what engineering is in our society, it is worth staging the history for the reader regarding the topic at hand. Although engineering of wheels, levers, and pulleys occurred in ancient times along with other engineering "products," the definition of engineering has been elusive to most people in society. Maybe because when educators say STEM (Science-Technology-Engineering-Math), they give examples of physics (which is science) or math. In society today, we teach mathematics in the first grade, and we teach science or physics typically in the fourth or fifth grade. When do we teach engineering in elementary education? "Never" is the common response. There does not exist a K–12 engineering curriculum in the U.S. that is commonly used. Outreach programs have become prevalent (Jeffers et al., 2004), but they are limited in scope and time. K12 Engineers Academy (2025) has just six levels, providing a certificate, and mainly focuses on software. K12 Engineering and Technology Pathway (2025) focuses more on mechanical engineering, and in particular robotics, and hosts six classes with no grade orientation. Project Lead The Way (PLTW) (2025) is probably the closest to the full K12 engineering curriculum, where they separate ages in the following three categories: 1) PreK–5th grade, 2) 6th–8th grade, and 3) high school engineering. However, PLTW's board is filled with people with business degrees and not engineering degrees, so they do not have a coherent K–12 paradigm as proposed herein. Finally, Feder et al. (2009), upon encouragement from the National Academy of Engineering, argued for the full commitment of the Kindergarten through High School Program that has yet to be realized based on the continued growing need for engineers in the U.S. The National Academy of Engineering (2010) followed this report with another one that helped define the standards for a K–12 engineering curriculum.

Why do we have "Technology" in STEM if people knew what engineers do? There may be other reasons why society does not understand what engineering is. Theodore von Karman, an aerospace engineer and the first National Medal of Science recipient given by President John F. Kennedy in 1963, helped to clarify engineering by stating the following: "Scientists discover the world that exists; engineers create the world that never was." Hence, science focuses on discovering phenomena in nature using the scientific method, but engineering produces technical innovations, "things," and processes. Based on von Karman's definition (2023), we can differentiate between science and engineering in a clear, distinct way. Even in PLTW, the focus on STEM with science and mathematics illustrates that it is not just engineering and the technologies developed by engineers that are the real focus. Finally, the National Academy of Engineering (2010) admitted that STEM was mostly focused on mathematics and science, and some of the technologies, but really not much on engineering.

Now, how did the word "engineering" arise? Contrary to Google's answer (2023), "derived from the Latin *ingenium* meaning clever or ingenious," it comes from those overseeing the "engines" of war, like catapults (Soedel and Foley, 1979; Rihill, 2007). Hence, those specialists were first called "engineers" in 1390 (Oxford, 2023). Later, Robert Fulton invented the steam engine in 1807 (Knox, 1887). The conclusion was that engineers worked on engines. Today, how many engineers worldwide work on engines? Approximately 2% in the USA (BLS, 2023), so not too many. Hence, the word engineer is a misnomer today; it should be 'creationeer' based on von Karman's definition.

In terms of educational processes, Rensselaer Polytechnic Institute was the first university to award a formal engineering degree in 1835 with a Bachelor of Science in Civil Engineering (ASCE, 2023). However, it was not until Schlager (1956) and Hall (1962) described Bell Telephone Laboratories that we garnered the term "systems engineering" during the 1940's, which encapsulated Bell Labs teaming environment to capture the different phases of design (conceptual, preliminary, and final) before ordering parts and assembling the products. The "systems engineering" paradigm was then transferred in the late 1940s and early 1950s (Fitts, 1951) to airplanes, helicopters, and missile defense systems (Goode and Machol, 1957). The first systems engineering degree started at the University of Arizona in 1961 (University of Arizona, 2023). However, it was not until 1990 that a group of systems engineers created a professional society for systems engineering, the National Council on Systems Engineering (NCOSE), which was changed in 1995 to the International Council on Systems Engineering (INCOSE, 2023). One can see that formalizing systems engineering thinking has been a fairly recent phenomenon when compared to other disciplines like physics, mathematics, etc.

In terms of bringing entrepreneurship and engineering together, probably the first to do so was Frank Turman, Dean of Engineering at Stanford University in 1951, for what we now call "Silicon Valley" (Foster, 1984, pp. 26–37). Turman changed farmland into the electronics industry, starting with Hewlett-Packard. Many other engineering corporations started from Stanford's engineering college, thus creating the computer industry as we know it today. From there, other institutions like MIT, the North Carolina Research Triangle, *etc*. developed technical corporations that arose from the local academic institutions, mainly from their engineering programs. However, it was not until 2005 that a formal academic networking group started for engineering entrepreneurship (KEEN, 2023).

To date, the full integration of a systems engineering approach joined with entrepreneurship in an educational curriculum has not been fully implemented in which each course taken is clearly defined in system so when a freshman starts in engineering, they know why each class is designed for their engineering degree and how they fit together as an engineering system with the opportunity to have entrepreneurship in their curriculum as a minor. Creationeering offers that unified approach, which integrates engineering and entrepreneurship at the undergraduate level. Beyond this, creationeering offers more than just an undergraduate engineering education.

The creationeering paradigm is proposed under the Dominion Mandate given by God in Genesis 1:26–28. Although an education program is not mentioned herein, it can be implied.

> Genesis 1:26–28 (NKJV)—Then God said, "Let Us make man in Our image, according to Our likeness; let them have dominion over the fish of the sea, over the birds of the air, and over the cattle, over all the earth and over every creeping thing that creeps on the earth." So God created man in His *own* image; in the image of God He created him; male and female He created them. Then God blessed them, and God said to them, "Be fruitful and multiply; fill the earth and subdue it; have dominion over the fish of the sea, over the birds of the air, and over every living thing that moves on the earth."

In the following sections, we discuss in order the systems engineering aspects in Section 2, the entrepreneurship aspects in Section 3, and the educational aspects in Section 4, including differentiating between K–5th grade, 6th-8th grades, high school, university undergraduate level, and university graduate school levels. In each section, to help exemplify the abstraction of creationeering, we use one of mankind's greatest engineering inventions in the twentieth century, an automobile, in the context of crashworthiness. The leading cause of death in the U.S. from ages 4–34 is vehicular crash (Ross et al., 2006). Figure 1 shows an example of four different length scales represented as a system, the subsystems, the modules, and the components (Woo, 2017). The automobile typically comprises approximately over 25,000 components made of different materials that have gone through different manufacturing processes.

Engineering Constituent of Creationeering

Creationeering provides a holistic systems perspective that integrates science, design, engineering, and entrepreneurship with a multiscale perspective on the design/control/energy volume from kindergarten to doctoral students. The engineering constituent of creationeering includes the following fundamental, independent, necessary, and sufficient eight required

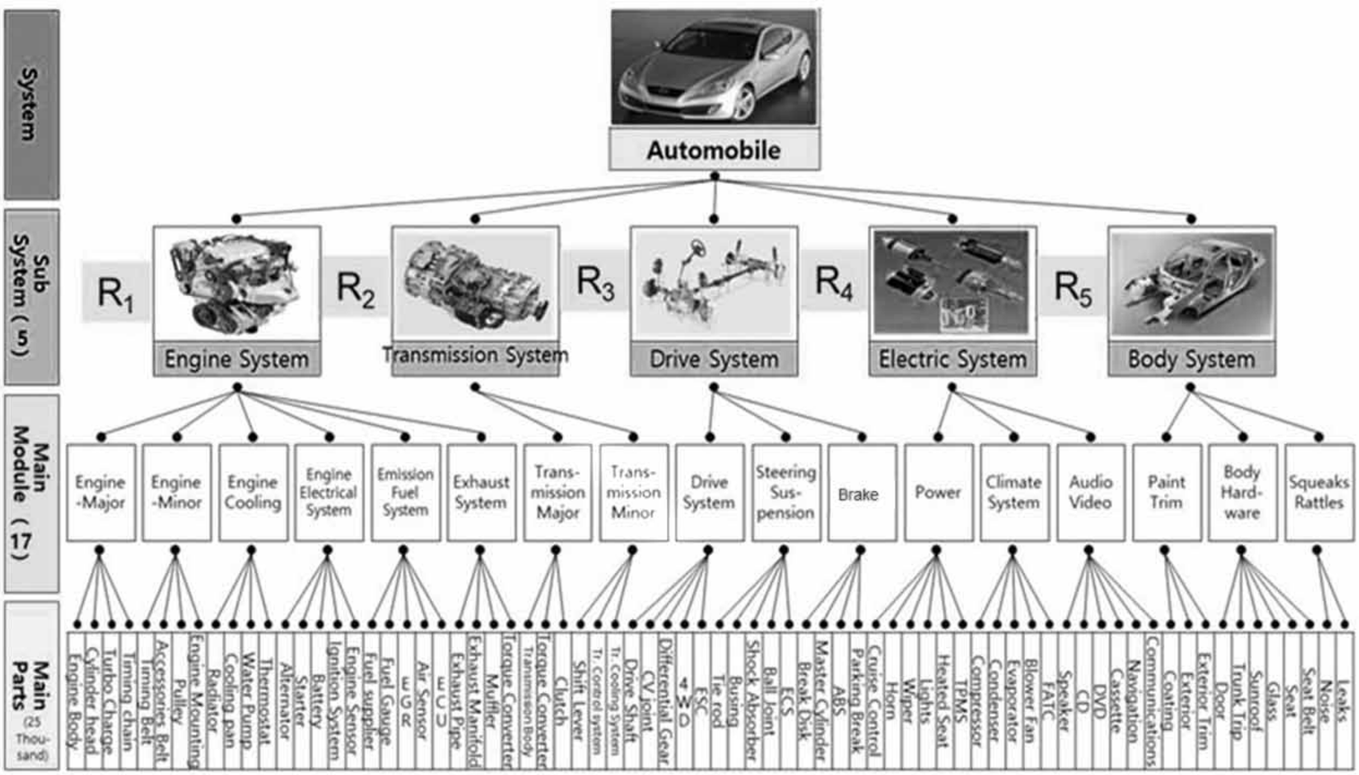

Figure 1. Systems engineering of an automobile that has a design life for 10 years, showing the four length scales of design: the top-level system, the five typical subsystems, 17 main modules, and the 25,000 parts. (Woo, 2017)

steps in any engineering system (see Figure 2):

1. *Design:* a thinking process that defines the engineering problem, includes ideation of solutions, and creates prototypes related to a product, process, software, or system. In defining the engineering problem, the objectives, constraints, and variables are specified and used to determine the possible solutions.
2. *Analysis/Synthesis:* computational and/or experimental evaluation of the designed prototype(s) by applying scientific analytic principles, processes, and tools to reveal the properties and state of a product, process, software, or system.

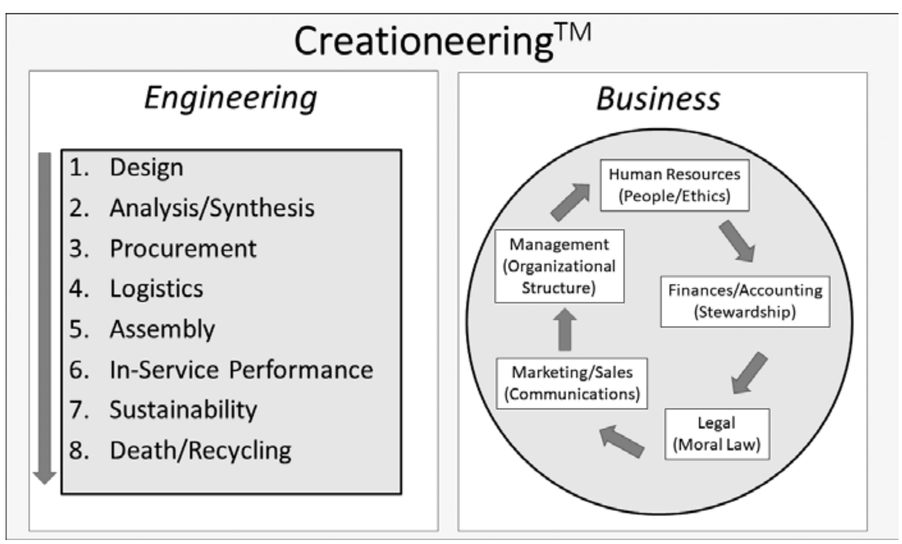

Figure 2. The engineering steps and independent features of a business that are required for an entrepreneur to start a technical business (Horstemeyer et al., 2022).

3. *Procurement or Materials Processing:* the "making" of the products as the final "thing" or for the process or system, also including the exchange of funds for the products and/or "things." The key aspect of making the products is the process-structure-property-performance sequence of a material in terms of the information passage to assure that the design is realized within the tolerances (uncertainties associated with the processes of making the products and/or "things.")
4. *Logistics:* the synchronization process of the distribution, transportation, and warehousing of the products and/or "things" where reliability, maintainability, and availability are dynamically changing before the products and/or "things" can be assembled.
5. *Assembly:* the process of putting components together to make a subsystem and putting subsystems together to make a system.
6. *Performance:* requirements for the life cycle of the product to properly function, considering normal and abnormal environments.
7. *Sustainability:* the operation of an engineering system that employs resources to remain after the process and product are completed. Reliability to continue the operation is oftentimes categorized in sustainability.
8. *Death/Recycling:* operation of performance afterlife in which it will be decided that the product will either be thrown away or returned as a new product after undergoing a new materials processing method.

Creationeering Step 1: Design

Design in engineering is a thought process of devising a component, subsystem, system, or process to meet desired objectives while considering the constraints and feasible variables.

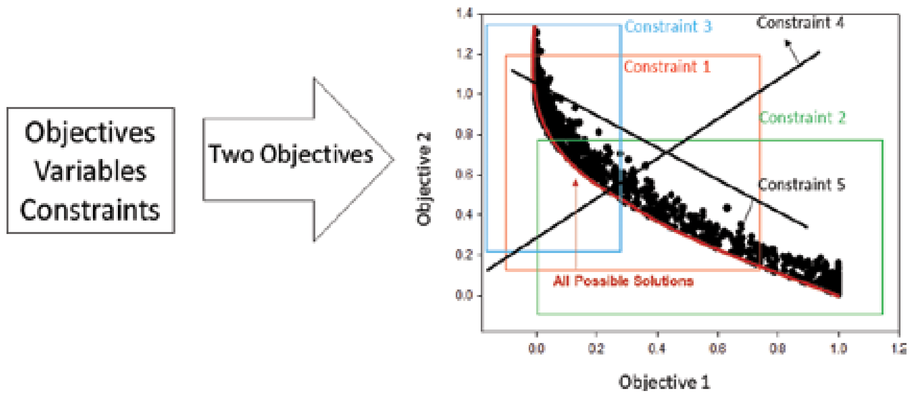

Figure 3. Schematic showing a Pareto (1920) frontier with associated constraints in a multi-objective optimization setup. Two objectives are illustrated.

Design is typically an iterative process at each length scale and certainly between length scales.

The design process includes objectives, constraints, and variables that are interrelated in a mathematical equation(s) with metrics that are optimized (c.f., Fang et al., 2005a,b; Johnson et al., 2016). There is a continuum from *strong* to *weak* sensitivities of the variables and constraints on the objective(s), which gives rise to uncertainties related to the solution (Coleman and Steele, 1999). How large the uncertainties are is related to the reliability of the solution (Pidong et al., 2017).

In a mathematical sense, an *objective* can be a numerical value or a function that can increase or decrease. For example, a designer may wish to maximize profit or minimize weight. Many mathematical equations can work with single objectives. As Figure 3 illustrates, a simple calculus differentiation can allow a gradient model to easily capture the minimum in the equation, which signifies the optimal solution. When using simple mathematical gradient methods, the designer normally weights the various objectives and sums them to form a single objective. However, Figure 3 also illustrates that a designer can have two or more objectives, which mathematically will introduce what is called a "Pareto Frontier" or sometimes "Pareto Front" (Pareto, 1920). The Pareto Front is the maroon line in Figure 3, illustrating that multiple solutions can satisfy the minimization, meaning there are multiple solutions. However, Figure 3 also illustrates that different constraints can come into and limit the solution space.

From a mathematical perspective, a *constraint* is a condition that must be satisfied for the design to be feasible. Examples include physical laws, limited human capital, funds, user requirements, or bounds on the validity of the mathematical models. Constraints in the mathematical equations can be used directly or can be incorporated into the objective using Lagrange multipliers (Lagrange, 1764, 1811; Rockafellar, 1993) to garner the optimal solution. The different constraints illustrated in Figure 3 limit the solution space and eliminate other possible solutions in the Pareto frontier. Constraints complicate the mathematical equations and decrease the number of possible solutions. Some constraints may be very limiting, and others may not.

A design *variable* is a parameter that is controllable by the designer but could vary depending on the constraints, and minimizing (or maximizing) the solution with respect to the mathematical equations (*e.g.*, thickness or a material type), and is often bounded by maximum and minimum values. In Figure 3, the possible solutions that are admissible after considering the constraints are still many. As such, the solution is typically decided by an engineer in practice. When only one objective is employed in the design analysis, then convergence on a single solution is possible, and an engineer is not necessarily required, because the mathematical equation will decide on the optimal solution. However, when more than one objective is included, then, by definition, since multiple answers are possible, it takes intelligence outside of the engineered system to make the decision on the design, so, hence, an engineer is required. This is consistent at any and every length scale.

Mathematics is the language by which to describe a design. The designer must choose a mathematical equation or set of equations to relate the constraints and objectives to the design variables. They may include complicated finite element analysis (cf., Fang et al., 2005b) and/or reduced order metamodels (cf., Fang et al., 2004, p. 4487). In the context of engineering or creationeering, a design is not the "thing" but only a logical and hopefully mathematical representation of the "thing," while making the "thing" occurs later in the creationeering process after the design is completed.

Design for Procurement

Materials Selection

Picking a material for a particular component requires a decision based on the objectives, constraints, and variables of how it could be made in an upscale manufacturing environment. Third Generation High Strength Steel Alloys can be made in the laboratory, but they cannot be mass-produced. Hence, when a designer is contemplating choosing a material or designing a material for a performance environment (s), one must also consider the material's processing method and the associated objectives, constraints, and variables. Probably the best materials database is from Granta (ANSYS) (Ashby, 2016), which offers a wide range of materials information for different applications. The objectives are related to the properties that are desired, given the constraints of the manufacturing method. Most times, cost is proportional to the volume of the material and is either a hard upper constraint or an objective to be minimized.

Manufacturing Method

Different manufacturing methods exist in order to create the material in the designed shape that is required to meet the engineering objectives. Some of the broad categories include the following: additive manufacturing, casting, forming, heat treatments, joining, machining, molding, and painting. The objectives are to maximize repeatability, minimize the out-of-tolerance requirements for the manufacturing method, and minimize production time. The main constraint is cost. The variables include the machinery, materials, and methods to optimize the objectives. "Concurrent Engineering" (Eppinger, 1991; Sohlenius, 1992) has historically been used to optimize the "performance" and "procurement" at multiple levels, within themselves and then together at the same time.

Design for Logistics

The objectives of designing for logistics are related to minimizing the time difference between assembly steps as the parts are shipped from Tier 1 or Tier 2 vendors. Because different part suppliers (Tier 1 and Tier 2 companies) are possible in a vehicle, different locations need to be assessed in terms of optimizing the "just-in-time" model. Another objective is to maximize the long-term relationship with suppliers for the logistical flow to be reliable. Constraints include product volume constraints, costs, timing, and distance. Some of the variables include transportation mode, costs, timing, and distance.

Design for Assembly

When one thinks of the massive changes that Ford (1913; Brinkley, 2003, p. xxii) introduced to upscale the automobile industry, one needs to go directly to his design for the assembly of such a historical achievement. El Wakil (1998) summarized the status and issues of designing for the assembly almost 100 years later. El Wakil (1998) compared and contrasted the human manual assembly method versus a robotic-automated assembly method, showing the differences in time, costs, and reliability. The objectives are basically to maximize the alignment and location of certain features for the process of assembly, minimize the number of different components in an assembly, minimize fastening screws (expensive and time-consuming), and minimize non-standard components/materials (risk goes up for new components/materials). The constraints include the following: (1) use the largest, rigid part of the assembly as a base or fixture to build upon; (2) avoid components from tangling or nesting during feeding; (3) avoid abrasive, fragile, and flexible components so that they do not retard feeding; (4) avoid re-orienting the assembly as it might require more machinery to support the assembly package. The variables include the machinery type, orientation angle, handling method, and feeding method of the components into the assembly.

Design for Life-Cycle Performance

Typically, when one thinks of designing something, they first think of designing for the "life cycle performance" environment, e.g., winning a race with a race car. The objectives for a car or van on the road has several objectives: (1) minimize damage to the people in the vehicle in a crash, (2) optimize to a certain sound (amplitude and frequency) for the brand of the vehicle (think Harley Davidson), (3) minimize temperature deviations from 70° F (Martinho et al., 2004) inside of the vehicle since that is the human body comfort, (4) minimize humidity deviations from 20% in the car cabin for maximum human body comfort, (5) maximize visual area of driver to keep vehicle safe, (6) minimize outside sounds to the people inside, and (7) minimize displacements of people inside vehicle upon various road conditions (pothole strike, panic brake, railroad strike, etc.). The constraints include the following: (1) keep the resonant frequencies away from 4–10 Hz at least for the driver since the human body parts in the torso region have a 4–10 Hz resonance and it could make the people sick in the vehicle; (2) the structural components should last 100,000 miles; (3) make seats comfortable for the driver and passenger to have customers want to stay in the vehicle; and (4) keep the car cabin noise below 8 dB (Olson, 1972) to keep the car quieter for better driver concentration.

Design for Sustainability

Sustainability can be thought of as sustaining the individual vehicle or sustaining the whole transportation industry. When considering the vehicle, let us consider a Chevrolet Corvette, since it has experienced eight generations in its existence. Each new generation tried to upgrade the vehicle and keep it modernized with the updated environment. In other words, the objectives and constraints changed thus modifying the design and actual vehicle. For example, the E-ray is a hybrid version of the Corvette, where the objective was to minimize carbon emissions from gasoline. When considering all of the transportation vehicles, one might try to minimize the carbon emissions to sustain our environment, so then the objective for transportation would be to minimize the carbon footprint. Thus, the fairly recent trend towards hybrid and electric vehicles arose.

Design for Death/Recycling

Typically, a vehicle's end-of-life is designed for 100,000 miles or ten years, so these would be constraints that would affect the mechanical design of the structural components based upon cyclic fatigue, creep, and crashworthiness. The question herein is what is the objective of the vehicle once it reaches death? Should the materials be recycled? Should the parts still useful be sent to other vehicles for replacement? The objective is typically to maximize profit from the materials once the car is considered "scrapped." Currently, most cars are sent to a scrapyard, where they are stripped of valuable parts, crushed, and recycled into scrap metal or plastic, and the nonrecyclable parts are sent to a landfill (Dean and Sterner, 1969; Adams, 1972).

Creationeering Step 2: Analysis/Synthesis of the Design

Analysis of information or synthesis of complex disparate information within a design includes the application of scientific principles and methods to assess the feasibility of the design. This includes analyzing the properties and state of the component, subsystem, or system. Careful evaluation and deliberation are fundamental to the analysis and/or synthesis of any design. Once a completed design is made into a prototype, then simulations and/or experiments can be used to validate the design (working hypothesis in the scientific method). Most vehicles like cars can be both simulated and experimentally validated (or rejected). However, some large structures like airplanes or submarines can only be tested in smaller scales whereas the larger scales are simulated. Hence, the modern analysis methods can be complex. We should also note that when analyzing the objectives of the design, the engineer must not only meet the technical objectives but also the appropriate aesthetics as well (Burgess, 2001). Getting the right balance of form and function is an art as well as a science.

Now that the overall car "system" has been conceptualized, analysis of the whole system, subsystems, and components is undertaken by a group of engineers in "normal" environments. Normal environments reflect the car functioning in its normal operations. Each engineering team will have different roles and responsibilities related to the engineering requirements "downscaled" from the whole system to the subsystems to the components. The second Design Phase, sometimes called the Preliminary Design or Detailed Design, is accomplished by the engineers based on their analysis. Each engineering team will consider the design for manufacturability (procurement), logistics, the assembly of the components and subsystems, its function/performance environments, sustainability of the car, and death/recycling.

Once this Detailed Design phase is finalized, then the cars will be designed for "abnormal" environments. Abnormal environments reflect the scenarios that can occur by accidents. For the car, the worst abnormal environment is a crash. As such, the most important focus in the final design phase is studying the crashworthiness of a vehicle. Once the final design has been experimentally validated, then the components are ready for procurement for the prototype that in turn will be analyzed by computational or experimental methods.

Creationeering Step 3: Procurement of the Materials for the Design

Procurement is the process of obtaining and the making of materials along with getting the equipment to make a component, subsystem, or system. Detailed knowledge of the definitions of the materials and the materials processing method are required. For example, components can be made from metals through wrought processes (stamping, forming, forging, etc.), casting, and additive manufacturing processes. Different metal chemistries that make up the metal alloys can be used in almost any of the materials-processing methods, which admits now multiple billions of variations of materials. Because there are approximately 25,000–30,000 components in a car, the Original Equipment Manager (OEM), like Ford Motor Company, General Motors Company, etc., having Tier 1, 2, and 3 suppliers is particularly important. Hence, each component is made in a different way.

Creationeering Step 4: Logistics of the Various Components and Subsystems

After something is designed and analyzed and ready to be made, then logistics is required to piece together all of the different personnel and materials to "systemize" the finalized design. Logistics can be defined as the selective application of scientific and engineering efforts undertaken during the acquisition process. The objectives of the design, not only of the product for the performance environment, but also for logistics, can be time efficiency, so that each step is coordinated together in time.

Related to logistics, the automotive supply chain for an Original Equipment Manager (OEM), for example, Ford Motor Company, includes the following: dealerships, manufacturers, Tier 1 suppliers, Tier 2 suppliers, and Tier 3 suppliers. Hence, the 25,000–30,000 components come from these companies, so organizing the scheduling of these components through different corporate bureaucracies is an effort. Logistical scheduling of the supply chain products is complex.

Creationeering Step 5: Assembly of the Various Components and Subsystems

Once the finalized designed parts are ready at hand, then they are ready to be assembled. Assembly refers to a number of parts or subassemblies or any combination thereof joined together to perform a specific function, and subject to disassembly without degradation of any of the parts (Hanifan, 2014, p. 23). Simply, it is putting parts together.

Mass production assembly is what made Henry Ford (1913) famous. Cars existed when Carl Benz (1879) in Germany created the first three-wheeled motor vehicle. However, Ford's first venture into automobile assembly with the Model A involved setting up assembly stands on which the whole vehicle was built, usually by a single assembler who fit an entire section of the car together in one place. This person performed the same activity over and over at his stationary assembly stand. To provide for more efficiency, Ford had parts delivered as needed to each workstation. In this way, each assembly fitter took about 8.5 hours to complete his assembly task. By the time the Model T was being developed, Ford had decided to use multiple assembly stands with assemblers moving from stand to stand, each performing a specific function. This process reduced the assembly time for each fitter from 8.5 hours to a mere 2.5 minutes by rendering each worker completely familiar with a specific task.

Creationeering Step 6: Function or In-Service Life Performance of the Engineered System

Once the validated designed "thing" is put together, then it is ready to perform its designed-for function. This entails the real-life performance of the "thing" so that it fulfills its objectives for which it was designed.

Engineers are not only interested in getting a product to market, but in determining how effectively that product accomplishes the goal for which it was created and how it survives through its routine use.

The reason that different Ford vehicles exist is that their performance or function is different. For example, the Ford Escort's performance objectives are related to increased gas mileage and lower vehicle cost, in contrast to the Ford F-150 truck's performance objectives, which are reliability, ability to pull heavy weights, off-road stability, and lower costs. These different objectives clearly have motivated the completely different designs of these vehicles.

Creationeering Step 7: Sustainability of the Engineered System

Sustainability means how the engineered component, subsystem, or system continues on to the next generation. Sustainability can be thought of as the ability of current generations to use resources so as not compromise the environment or deplete the materials for future generations. To enable all people throughout the world to satisfy their basic needs and enjoy a better quality of life, without compromising the quality of life, affects future generations.

Each engineering team for each car provides minor adjustments to the next year's version to continuously improve the car's usage. Reports from consumers come back to the design team, who then start the creationeering process over for the next-generation vehicle.

Creationeering Step 8: Death/Recycling of the Engineered System

The final stage that an engineer must consider is what to do with the materials once the designed performance of the product is over. Recycling is converting an already existing product or material into a new product. One could consider a system of materials circulation when a materials first objective is over, that there can be a secondary objective of the used product. At this point, the secondary product might need to go through reprocessing to reach its objectives.

Each vehicle is designed for a particular lifetime. For example, a Ford F-150 truck will typically meet an objective of 150,000 miles, while some will reach a stretch objective of 300,000 miles. However, a Ford Escort can last between 100,000 and 200,000 miles. Because the environmental conditions and road usage are different, the 'death' of the vehicle will occur at different times.

Vehicle recycling comprises the dismantling of vehicles into separate parts, some for reuse and others for different reprocessing. Approximately 12–15 million vehicles reach the end of their useful life each year in just the United States alone. The vehicles are shredded, and the metals, polymers, and glass are recovered for recycling, while in many areas, the rest is further sorted by machine for recycling of additional materials. The remainder, known as automotive shredder residue, is put into a landfill. The shredder residue of the vehicles that is not recovered for metal contains many other recyclable materials, including 30% of it as polymers, and 5–10% of it as residual metals. Modern vehicle recycling attempts to be as cost-effective as possible in recycling those residual materials. Currently, 75% of the materials can be recycled, with the remaining 25% ending up as landfill. As the most recycled consumer product, end-of-life vehicles provide the steel industry with more than 14 million tons of steel. A car crusher is often used to reduce the size of the scrapped vehicle for transportation to a steel mill.

Entrepreneurship Constituent of Creationeering

The five fundamental, independent features of a business enterprise or entrepreneurship required to start a business, as shown in Figure 2, are the following:

1. *Human Resources*: the hiring, administration, and training of personnel with ethical standards. The basic ethical basis to undergird human relationships is service-to-one-another as a team, then science, engineering, and entrepreneurship (business) will not be self-centered and oriented towards the team. Tommy Lasorda, former Los Angeles Dodgers baseball coach, always told his players to play for the name on the front of their jersey (the team) and not for the name on the back of the jersey (their own self).
2. *Finances*: management, accounting, and stewardship of money as a commodity to achieve the goals of the business. Herein, one must first make strategic (long-term) goals, from which arise tactical goals (short-term) that can be met with certain finances. The finances are then used to hire people, facilities, equipment, etc., to meet the goals. If finances are the only objective, to maximize profit without any other objectives or constraints, then the engineering system will fail. One can recall 1 Timothy 6:10a (KJV): the love of money is the root of all evil. It is not bad to have an increasing profit; it is just bad to have it without other objectives and constraints to bring that objective into balance for the whole system to thrive.
3. *Legal* an entity requires compliance with laws related to intellectual property, litigation, investigations, and acquisitions. Furthermore, one could place ethics into this category to help the value system of the new technology corporation.
4. *Marketing/Sales*: the action of communicating and connecting the products with the consumers with the Professional Engineering ethics basis of truth, honesty, and meeting genuine client needs.
5. *Management*: an organizational structure to admit the rules, roles, and responsibilities for individuals to operate.

Human Resources Used in the Creationeered System

The term "Human Resources" for a business is to recruit, train, develop, compensate, team-build, conduct performance appraisal, communicate worker health and safety issues, and identify methods for selecting staff for the business system.

Along with managers, the auto industry requires different sets of requirements for the working team. Related to the engineering process, the auto industry requires designers, analysts, materials producers, logistics operators, assemblers, and recyclers. There are different roles and responsibilities for the Original Equipment Manufacturers (OEMs), Tier 1, Tier 2, and Tier 3 corporations throughout the whole supply chain.

Finances/Accounting Used in the Creationeered System

Our Creator has expressed his concern through Jesus in humans being good stewards of the resources that the Creator has supplied for us. Finance and accounting can be defined as the management, allocation, and exchange of resources for the business system.

The largest market in the world is the automotive industry, so different jobs related to money are typical of almost any industry. The following positions are needed: accountants, insurance agents, financial planners, ethics and auditors, etc.

Legal Aspect of the Creationeered System

Most humans have the tendency to believe in moral obligations and responsibilities. Almost everyone (with a few exceptions) believes that it is right to show kindness and wrong to inflict pain on another person.

Legal issues arise from governmental laws and certification boards. Automotive companies have lawyers who address intellectual property, personnel employment issues, insurance, corporate policies, and immigration.

Sales/Marketing Related to the Creationeered System

Sales and marketing are communications of information from the business system to those outside of the system. In other words, interpersonal communications are key to sales and marketing. The sales and marketing personnel's objectives are to maximize clarity of the needs of those outside the business system with those inside the company.

As mentioned, the largest market in the world is the automotive industry, so marketing and selling to the different nations/cultures is a key job. For example, crossover vehicles represent the largest market in the USA [https://www.statista.com/statistics/276506/change-in-us-car-demand-by-vehicle-type/]. The Volkswagen Golf was the number one car sold in Europe in 2019 [https://www.best-selling-cars.com/europe/2019-full-year-europe-best-selling-car-models/], and the number one 2017 vehicle sold in China was the Wuling Hongguang [https://www.goodwood.com/grr/road/news/2018/4/axons-automotive-anorak-chinas-best-selling-cars/].

Management of the Creationeered System

Management is an organizational structure of the business system. The Creator ordered from the very beginning an ordered, organizational structure that started with the family unit, where the father was the accountable entity of the family unit. A good management structure is therefore key to the success of any system.

Ford Motor Company has a fairly low number of management levels, as they believe that it provides a faster, more efficient, and integrated approach to customer service (Moynihan and Titley, 2000). Their structure is outlined as follows: Chairman, President, Executive Vice-President, and Functional Heads. The functional heads have a direct relationship with the workers in each of the categories of the personnel structure. Each company is different based on its ethics and human personnel strategy.

Creationeering K–12 Education

The K–12 educational aspects for creationeering can be focused on the engineering aspect of the paradigm and not so much on the business side. Various instructional methods are used to reinforce the engineering process steps. In particular, the early focus is on the "design" and "analysis" steps of the engineering process in which the NRS (1996) is used. In particular, three areas are considered: (1) Physical Science Content Standard B—"As a result of their activities in grades 9–12 all students should develop an understanding of motion and forces" (NRS, 1996, p. 149); (2) Science Education Program Standard B—"The program of study in science for all students should be developmentally appropriate, interesting, and relevant to students' lives: emphasize student understanding through inquiry: and be connected with other school subjects" (NRC, 1996, p. 212); and (3) Science Education Program Standard C—"The science program should be coordinated with the mathematics program to enhance student use and understanding of mathematics in the study of science and to improve student understanding of mathematics" (NRS, 1996, p. 214).

Hands-on experiments for the "assembly," "performance," and "sustainability" steps of the engineering process are used to demonstrate the crashworthiness concepts for automotive design. Since children can identify with an automobile and safety, this example is excellent for learning. Experiments with simple examples of the eight steps, associated discussions, and open-ended questions are key for K–5 learning. For Grades 6–12, along with the experiments and associated discussions and open-ended questions, additional design complexities and analysis with math and physics are included. The crashworthiness example can include physics principles in car crashes, teacher explanations of the physics applications, a list of materials for each lesson, and vocabulary words and definitions.

Another instructional piece is related to vehicular safety. Some of the topics include the following: discussion of highway safety statistics, collisions and effect on the vehicle and passengers with and without seat belts and air bags, and physics lessons associated with the safety features on vehicles.

The instructional goals include the following: (1) to create an interest in engineering for students in grades K–12, (2) to promote safe driving practices to decrease deaths and injuries in car crashes, and (3) to enhance the level of understanding of science and engineering in grades K–12 by providing detailed hands-on science activities for K–12 teachers.

K–12 Experimental, Lessons, and Activities

Based upon NRS (1996) standards, different levels of understanding scientific concepts have been defined and used in the development of the "analysis" of the "designs" for the car crash scenarios. The following science topics are considered in the engineering design of the crashworthiness vehicles:

1. *Energy*: For grades K–5 students, study potential and kinetic energy in a qualitative sense using the examples of a car rolling from rest down an inclined plane. Energy transformation and conservation of energy are discussed. For Grades 6–12 students, study conservation of energy from both a qualitative and quantitative perspective. Students solve age-appropriate conservation of energy problems associated with the motion of objects. Emphasis is placed on the transformation of kinetic energy to other forms during inelastic collisions. The deformation of various types of materials is discussed in terms of conservation of energy.
2. *Velocity and Acceleration*: In Grades K–5, students study velocity and acceleration from a qualitative perspective. This activity involves students stepping onto a series of evenly spaced lines on the floor at one-second intervals. The distance between the evenly spaced lines is increased to demonstrate increased velocity. To demonstrate acceleration, the distance between the lines is not evenly spaced but increases with each successive line. For Grades 6–12, students study velocity and acceleration from both a qualitative and quantitative perspective. Students solve age-appropriate velocity and acceleration problems and determine velocity and acceleration from displacement-versus-time and velocity-versus-time graphs. Students distinguish between vectors and scalars. Students also conduct the velocity and acceleration activity using timed intervals for uniformly spaced and non-uniformly spaced taped lines.
3. *Conservation of Momentum Demonstration and Newton's Laws*: In Grades K–5, students are introduced to the concepts of conservation of momentum and the relationship between impulse and change in momentum using balloons, Newton's cradles, Hot Wheels cars, happy/unhappy balls, and modeling clay. They also relate the concepts of conservation of momentum and Newton's Laws to car safety and collisions. Emphasis is placed on the relationship between the time it takes to stop an object and the magnitude of the force required to stop the object. The effect of deformation of various types of materials upon the time to bring the occupants in a vehicle to a complete stop is also discussed. For Grades 6–12, students study conservation of momentum and Newton's laws from both a qualitative and quantitative perspective. Students solve conservation of momentum and impulse-change in momentum problems. They also relate the concepts of conservation of momentum and Newton's Laws to car safety and collisions. Emphasis is placed on the relationship between the time it takes to stop and object and the magnitude of the force required to stop the object. The effect of deformation of various types of materials upon the time to bring the occupants in a vehicle to a complete stop is also discussed.
4. *Stop That Egg Activity*: The purpose of this activity is to reinforce the relationship between impulse and change in momentum in a qualitative sense. This activity is the same for students in grades K–5 and 6–12. Students are first asked to throw an egg into a bed sheet held vertically and perpendicular to the ground by two other students. The students are told to throw the egg as fast as they can in an attempt to break it. Because of the deformation of the sheet, it is virtually impossible to break the egg due to the increased time to stop it. Students also relate this activity to the functioning of an airbag in vehicles.
5. *Egg Toss Activity*: Students are then to play egg toss with a partner at ever-increasing distances. This activity is the same for students in Grades K–5 and 6–12. Students quickly learn that they must "give" with the egg and therefore increase the time to stop the egg to prevent it from breaking. This activity may also be implemented as a student competition. This activity also reinforces the relationship between impulse and change in momentum.
6. *Passenger Restraint Systems Activity*: The purpose of this activity is to have students design, analyze, and procure the materials for a passenger restraint system for a passenger (raw egg) that is aboard a wooden car. This activity is the same for students in Grades K–5 and 6–12. Hence, the performance environment is the car rolling down an inclined plane and colliding with a vertical wall. Using the scientific method, students prepare a hypothesis as to which type of restraint system would best protect the egg in a collision. Students then select their material and test it by allowing the car to roll down the ramp and collide with a stationary barrier at the end. Success is measured by whether or not the passen-

ger (egg) is damaged. The students can then redesign the restraint in a sustainable sense. The broken eggs are thrown away upon their "death." The scientific concepts of conservation of momentum and conservation of energy provide the basis for their analysis.

7. *Safety and the Collision Effects upon Passengers*: This phase includes analysis of reaction times, safe following distances, and the forces on passengers in collisions involving various types of restraint systems. Conservation of energy, crumple zones, and vehicle deformation are also included in this chapter. Age-appropriate activities and problem computations are provided for K–12 students.

K–12 Student Competitions

Along with experiments for learning, the authors encourage "competitions" between student groups to help learn the engineering process. The first competition is called "Mission Eggscellence," which demonstrates the application of the eight engineering steps to a bumper on a small car in which an uncooked egg is used as a passenger. The goal is not to allow the egg to crack in the crash. The second competition is called an "Automotive Challenge," which demonstrates the engineering step of procuring a restraint system (seat belt) for the egg in a crash, where the egg represents a passenger. Again, the egg should not crack upon impact. Different impact velocities are achieved by raising the board height, which acts as a track, on which the vehicle rides. It impacts another board at the bottom of the track. The egg should be placed in a sealed paper "baggie" before placing it into the vehicle. The competition includes guidelines for logistics related to pre-competition planning, "day of" competition planning, competition setup, and organizational instructions.

Figure 4. Three middle school students are getting ready to release the vehicle with the egg in it for the Mission Eggscellence competition.

Mission Eggcellence Challenge

In the Mission Eggcellence Challenge, the students are given a previously constructed car which consists of a 12-inch-long, 2-by-4-foot board with skate wheels attached. Students (see Figure 4) design a bumper for a wooden car that will keep a passenger (raw egg) safe. The bumpers, constructed within stated parameters, are attached to the cars using Velcro strips. The egg is restrained by two Velcro strips so the design of the restraint system is not part of the competition. Students use the concepts of impulse and change of momentum, as well as energy dissipation in the deformation of materials, as analysis tools in designing their bumpers. The car's performance objective is to minimize damage to the egg as it rolls down an eight-foot-long inclined ramp and impacts a vertical barrier. Students are eliminated from the competition if the egg breaks during the collision. The angle of inclination of the ramp is increased after each successful run until a winner emerges. In a tie, the winner is the car that uses the bumper with the smallest mass. The Mission Eggcellence Challenge is conducted in the same manner for students in Grades K–5 and 6–12.

Automotive Engineering Challenge

The Automotive Engineering Challenge is based on vehicle safety. The K–2 and 3–5 students use K'nex (or comparable plastic construction kit) components to design, analyze, and assemble a car that will house a raw egg. This car and passenger (raw egg) travel down an eight-foot ramp to impact a barrier (see Figure 5). Emphasis in this competition is placed upon both the design of the front end of the vehicle and the type of restraint system used to hold the egg during impact. The competitions are conducted in the same manner as the Mission Eggcel-

Figure 5. (a) Three middle school students are getting ready to release the vehicle with the egg in it for the Automotive Engineering Challenge competition. (b) Note the K'nex vehicle design for this particular student team.

lence Challenge, in which the winner is determined by the vehicle in which the egg survives the highest angle of inclination without breaking. In case of a tie, the winner is determined to be the car with the smallest mass.

For Grades 6–8 and 9–12, students must design and construct their car from balsa wood and glue. Since the platform for each car is a rectangular piece of balsa wood with a square front end, the emphasis for students in Grades 6–12 is entirely on the construction of the passenger restraint system. This car and passenger (raw egg) also travel down an eight-foot-long inclined ramp to impact a barrier. The wheels for the car consist of compact discs with a plastic hub insert, which has a ¼ inch hole for an axle. The rules for competition are the same for Grades K–5 and 6–12.

Undergraduate Engineering Education

The creationeering paradigm can be applied directly to each and every major engineering program/discipline [ABET, 2012] with a technological entrepreneurship minor. We show, herein, in Table I, the ABET-accredited mechanical engineering program employed at Liberty University. The example of mechanical engineering with an emphasis on automotive engineering illustrated in this paper can be extended to any other engineering discipline. Also, the thinking processes of organization, analysis, and prioritization that are typical of undergraduate engineering curricula are present here in the creationeering paradigm.

Etzkowitz et al. (2000) argued that the future of STEM education will need a stronger emphasis on entrepreneurship. The argument arises from internal university "push" and external industry "pull" on academic structures to develop new "knowledge-based" innovations. Table II summarizes the courses needed for a Technological Entrepreneurship program that Liberty University School of Engineering has developed.

Graduate School Engineering Education

The creationeering paradigm can be applied to any graduate program, albeit the emphasis is usually on the "analysis/synthesis" tools development of the engineering process, although one could argue that there have been many different PhD theses that have addressed design, materials processing, logistics, assembly, sustainability, and recycling as well. We note that some engineering schools are creative in innovating with new corporations based on the graduate-level research. Roach et al. (2019, pp. 207–228) surveyed students from 40 different USA universities and showed that between 16–26% of the graduate students were interested in developing a start-up company from their research. Recently, Colombelli et al. (2021) analyzed a group of PhD students, of which 50% were involved with entrepreneurship. The quantified evidence revealed a positive effect of the entrepreneurial education program on the academic and business outcomes. In other words,

Table I. Example of curriculum for the Mechanical Engineering major, illustrating how each course fits into the creation-eering paradigm (Year 1 = YR1; Year 2 = YR2; Year 3 = YR3, Year 4 = YR4).

Course Number	Course Name	Design	Analysis	Procure-ment/ Making Things	Logis-tics	Assem-bly	Life-Cycle Perfor-mance	Sustain-ability	Death/ Recy-cling
ENGR102	Engineering Intro	YR1							
ENGR110	Engineering Problem Solving Intro	YR1	YR1						
ENGR 125	Visualization Tools		YR2						
ENGR 133	MATLAB		YR1						
Math131	Calc 1		YR1						
Math 132	Calc 2		YR1						
Math 231	Calc 3		YR2						
Math 334	Diff Eq		YR2						
Chem 121	Chemistry		YR2						
Physics 231	Physics 1		YR1						
Physics 232	Physics 2		YR2						
Physics 320	Thermo 1		YR2						
ENGR 210	Statistics	YR2	YR2		YR2	YR2	YR2	YR2	YR2
ENGR 235	Statics						YR2		
ENGR 240	Dynamics			YR2			YR2		
ENGM 310	Materials			YR2			YR2	YR2	YR2
ENGR 313	Mechatronics						YR4	YR4	
ENGR 315	Fluid Dynamics		YR3	YR3			YR3		YR3
ENGR 330	Strength of Materials		YR3	YR3			YR3	YR3	YR3
ENGM 350	Computer Aided Engrg	YR3	YR3				YR3		
ENGR 360	Heat Transfer			YR3			YR3		YR3
ENGM 375	Thermal Fluids Lab			YR3			YR3		
ENGR 381	Engrg Design Intro	YR3	YR3						
ENGR 385	Thermo II						YR3	YR3	
ENGR405	Dynamic Systems Modeling		YR4				YR4	YR4	
ENGR 415	Machine Design	YR4					YR4	YR4	
ENGR 445	Manufacturing Processes			YR4					
ENGR 481	Engring Design 1	YR4	YR4						
ENGR 482	Engring Design 2	YR4	YR4	YR4					
ENGR 200	Comp Teams	YR1–YR4	YR1–YR4	YR1–YR4	YR1–YR4	YR1–YR4	YR1–YR4	YR1–YR4	YR1–YR4

Table II. Example of the Technology Entrepreneurship minor for science, technology, engineering, and mathematics (STEM) undergraduate students illustrating how each course fits into the ereationeering paradigm.

Course Number	Course Name	Human Personnel	Finance	Legal	Sales/ Marketing	Management
ENGR 202	Creationeering Intro	X	X			
ENGI 220	Engineering Economy		X			
Busi 336	Entrepreneurship Intro	X	X	X	X	X
Busi 338	Developing Entrepreneurial Opportunities	X	X	X	X	X
ENGR 470	Technology and Business Practicum 1	X	X	X	X	X
ENGR 475	Technology and Business Practicum 2	X	X	X	X	X

if no industry "pull" exists, then the knowledge "push" from the scientific research will not necessarily move into the space that is helpful for industry. When the knowledge "push" is constrained with the industry "pull," then new domains for new corporations are created. Thus, the creationeering paradigm can create new businesses to help create wealth.

Discussion

The following quote from St. Hill et al. (2013) provides a nice parable for creationeering. "'Give a man a fish; you have fed him for a day. Teach a man to fish, and you have fed him for a lifetime'—Lao Tsu, Chinese philosopher. Revised saying, 'Give a man a fish; you have fed him for today. Teach a man to fish, and you have fed him for a lifetime. Teach a man how to establish a fishing business, and you not only feed him for a lifetime but bring benefits to his family and the community.'" As a creationeer, one can realize the connection from scientific research through the engineering process into the entrepreneurial corporations to genuinely affect the economic, social, environmental, and spiritual transformation of a culture.

These five "business" aspects comprise a system of independent, necessary, and sufficient characteristics that lay the foundation for any corporation. Each of the eight engineering and five business features is independent and necessary to each other in the mathematical and logical sense when thinking about first principles. The ethics statement from the National Society of Professional Engineers (NSPE) lays out seven canons that undergird the whole creationeering system:

1. "Hold paramount the safety, health, and welfare of the public.
2. Perform services only in areas of their competence.
3. Issue public statements only in an objective and truthful manner.
4. Act for each employer or client as faithful agents or trustees.
5. Avoid deceptive acts.
6. Conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession."

Summary

Creationeering can be thought of as the following: Create the prototype using the scientific method! Create the engineered product! Create the Intellectual Property! Create the business! From an educational perspective, we need to educate our children with this paradigm, such that when the engineering process and business/entrepreneurship process combine, a modern industrial revolution can arise. If we can train our students with the creationeering paradigm, we are encouraging a clear opportunity for them to rule and reign on the Earth to serve mankind and fulfill God's Dominion Mandate.

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Positionality Statement*: My frame-of-reference comes from my experiences in Mechanical Engineering Education, earning a BS from West Virginia University, an MS from Ohio State University, and a PhD from Georgia Tech. I also taught Mechanical Engineering classes, both undergraduate and graduate, at Mississippi State University and Liberty University. Also, working at Owen Corning Fiberglas and Sandia National Laboratories, I was heavily involved in the science and engineering methodologies. Regarding entrepreneurship, I have started three different companies, so these experiences have biased my position. Finally, I have spoken at many primary and secondary schools (private and public) about science, engineering, and mathematics, and have found that most teachers and students do not really know the process of engineering.*

Artificial Intelligence*: None of this work used any form of artificial intelligence. By submitting this manuscript, I confirm that I have adhered to appropriate ethical guidelines or approvals for the human subjects research conducted in this study, including taking into consideration any federal requirements and institutional guidelines concerning the use of AI in human subjects research.*