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Practitioner's View on the Future of Economic Decision-Making in Project Management:
A Research Note

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ABSTRACT

As of now, the best means to plan for the future is project management because it has been proven effective in problem-solving and generating solutions. Few projects entail economic decision-making because of the cost factor, but the wrong decisions can be made because of the complications that come with making economic decisions. However, financial decision-making does not only entail gathering information and making decisions accordingly. The economy must be analyzed and the future economy must be estimated for any economic decisions to be viable. This study highlights the future trend, as well as the significance of economic decision-making within project management. Furthermore, it tests several factors: economic decision-making influence, creativity, risk profile, and the management team size for a successful project. Primarily, this study will assess how significant economic decision-making is in project management.

KEYWORDS

Economic Decision-Making, Future, Project Management, Risk

INTRODUCTION

The Future of Economic Decision-Making in Project Management

There are many fields of application that involve mathematical methods and computer technology, but human activity is still essential. With decision-making, the outcome can be very serious because it is a matter of selecting a strategy that can result in certain consequences. Thus, decision-making is considered a unique

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type of human activity because it entails the selection of one solution from various options (Best, 2016). It is a complex process that requires significant mental effort for those who have made such a choice in business or personal environments (Galli, 2018b; Caro, Briggs, & Siebert, 2012). Thus, methods that guide people to understand any wants and needs are valuable, as one can assess desired goals and available resources for any position.

The most helpful decision-making methods were emphasized by practitioners and theoreticians for many years. Also, economists built on such methods, as well as specialists in state or administrative management, attorneys, and the military (Caro, Briggs, & Siebert, 2012). Recently, the focus has shifted to how decisions are made and how it is helpful during difficult problem-solving situations. During decision-making, problems are addressed from unified positions, rather than from the particular areas of application (Caro, Briggs, & Siebert, 2012). Various studies illustrate that there are shared characteristics in human behaviors during economic, political, social, and technical decision-making situations. Though human behavior is varied, behaviors are alike in given circumstances to determine the standard methodological tasks for the specific decision theory (Tatić & Činjarević, 2016).

Progressive and project management are needed to address institutional and social issues (Caro, Briggs, & Siebert, 2012). Project management has evolved into the contemporary method for planning for the future, as well as addressing current issues in the community. Thus, one must study the best practices for projects that will guarantee success (Fox, 2016). When a project fails, one must pinpoint what went wrong in a total or partial manner.

This study will highlight future economic decision-making in project management. Furthermore, economic decisions involve financial decisions, as well as decisions made daily from an individual level to banks within multiple countries. Globalization has caused the economy to become interdependent, so it is difficult to assess. Thus, this evaluation is done with models for predicting future economic movements, as economic decisions are best made by accurately analyzing the economic situation. This study attempts to find if economic decisions lead to a project's success or failure.

Problem Statement

Social and economic environments are fluctuating significantly. Thus, project managers undergo certain challenges because they must always make good decisions, but it is not easy to do so in a complex environment (Fatfouta et al., 2015). Previous methods may not be applicable to current situations, so one must understand the future economic decision-making in project management. This study aims to uncover mathematical models for future economic decisions in project management. Additionally, this study seeks to research the applicable mathematical models and methods in a project environment. Lastly, this study aims to research any factors that need consideration when applying mathematical models.

Contribution to the Field and Profession of Industrial Engineering

This research is of great importance to the industrial engineering (IE) profession and research field, as it contains helpful information to save on aspects that would impede on productivity: time, materials, money, energy, work hours, and other resources. As a result, goals can be achieved more quickly and effectively. Furthermore, this research directs engineers on classifying and preserving the system through the use of current technology. Engineers will see that their productivity and work quality will improve substantially. The model is helpful for many aspects of businesses, such as their products, and can provide practitioners with valuable strategies.

Additionally, this study features clear vocabulary for any reader, so it can provide everyone (including industrialists) with vital information. This research explores an unchartered side of the future of economic decisions in project management. However, it also proves how important and effective this model is for businesses. There is a general outline in this study for readers to find relevant details, so it can be easily referenced in future studies. Thus, any business can advance in competition over other businesses, as this study provides essential research for the IE profession and research field.

FINDINGS

Clearly, future decision-making processes will be methodical, based on evidence, and less subjective compared to past and current decision-making techniques. Also, future decision-making will emphasize certain models that are exclusive to a specific system (Fung, 2015).

How Future Economic Modeling May Change

When classifying managerial decisions, there are numerous views, such as that management decisions are categorized as general or private. General decisions entail that the subject is further developed (Grover, 2016). Essentially, decisions influence production, finances, and economic activities of a business. Private solutions are required in current and operational activities: discipline, layoffs, and alterations to the work schedule (Galli, 2018c; Virine & Trumper, 2017).

Another classification entails that management decisions are known to affect the external and internal environment. External environments address the near environment, associates, clientele, and creditors, such as needing a bank loan (Grau-Moya, Ortega, & Braun, 2016). Meanwhile, internal environments concern a managed system, such as altering the staffing schedule and executing production tasks (Galli, 2018a; Grover, 2016).

There is a hierarchy level for classifying management decisions. The levels are contingent on the nature of the issue and the competence of each hierarchy level (Virine & Trumper, 2017). Furthermore, management decisions are separated into rational decisions or are assessed by judgments or intuitions. Judgments are warranted with an objective analytical method, but intuitions involve personal experience and personal

judgment (Grau-Moya, Ortega, & Braun, 2016). Intuition involves the imagination or insight that is usually derived from the conscious understanding of the problem and the decision-making that follows (Virine & Trumper, 2017).

Primarily, conducting decision-making procedures entails utilizing modern information technologies, as well as computerized programs (Grover, 2016). Now, expert systems are being developed to collect professional knowledge for various situations that necessitate competent evaluations (Virine & Trumper, 2017). Applying economic and mathematical methods for solving management problems involves certain criterion to maximize or minimize the objective function: optimization (Grau-Moya, Ortega, & Braun, 2016). The optimal solution is found by comparing the quantitative value of the objective function to find which offers the most favorable value of the target criterion (i.e. maximize profit, income, or minimize cost) (Grover, 2016).

Essentially, the management decision involves selecting the best choice amongst certain options, but it can involve selecting the most useful strategies. Time is a crucial factor in modern conditions during decision-making processes, information irregularity, and costs of transactions (Grover, 2016).

Mathematical Models are Likely to Dominate the Future

In the future, modeling will most likely undergo significant changes. As a method of cognition, it should be noted that modeling is rooted in the idea that every model is a reflection of reality (Stewart et al., 2012). Many models are created under different means, conditions, and objects of cognition that are understood as property (Galli, 2018b; Stewart et al., 2012). Though there are various principles for classifying models, the most significant are those through mapping reality (apparatus of construction) and those through the nature of what is being modeled (content).

There are two models through mapping or through the apparatus of construction; firstly, there is material and mental, and secondly, there is ideal (Hair et al., 2014). At the core of constructing such models, there must be physical similarity: the identity of the physical nature and the laws of motion (Stewart et al., 2012). On a mathematical level, similar models have equal mathematical formalism in some way that depicts the object and model behavior, such as with analog computers and cybernetic functional models (Grau-Moya, Ortega, & Braun, 2016). Additionally, these material models are not the mathematical relationships, but they are the real or physical shells of them.

There are three categories for mental or ideal models:

1. **Descriptive or conceptual models:** Expresses relations through images of the language;
2. **Visual-figurative models:** The constructed images are derived from sensory-visual aspects (Grau-Moya, Ortega, & Braun, 2016);
3. **Signed models:** Includes mathematical models with object elements and relations that are illustrated with signs, mathematical symbols, and formulas (Grau-Moya, Ortega, & Braun, 2016).

Certain tasks or functions of management require certain models for calendar planning, enterprise development management, quality control, and more. Since models of this subdivision highlight specific socio-economic tasks, they must ensure the numerical form of these results (Grau-Moya, Ortega, & Braun, 2016). If the stage or procedure of automation management is a particular kind, then models can be informational and mathematical software (Stewart et al., 2012). Models within this unit are directed towards the relevant stages to move and process information (Table 1).

One can find the extreme values of complex functions, which depend on a large number of arguments, with random search methods (Grau-Moya, Ortega, & Braun, 2016). The random choice of arguments mechanism acts as the core of these methods, which also carries out the minimization. Random search methods are used in situations such as modeling organizational management structures (Virine & Trumper, 2017).

When there is uncertainty, an incomplete amount of information, and an associated risk, game-theoretic models are used (Blokhuis et al., 2012). These methods contain game theory and the theory of analytical solutions, and game theory addresses conflict situations. Furthermore, game theory is applicable when uncertainty is at the hands of any potential actions from incompatible parties. Thus, game-theoretic models are best for preparing, conducting, and evaluating business game results.

The mathematical models can be further divided into two models: the efficiency assessment model and the optimization model (Grover, 2016). Firstly, efficiency evaluation models assist in the development of a business' characteristics or management. This group contains all probabilistic models. Secondly, with the optimization models, models of performance evaluation are considered "input" (Virine & Trumper, 2017). Optimization models also include extreme and statistical models, models of mathematical programming, and game-theoretic models. Furthermore, optimization models are intended to choose the optimal plan of action in certain situations (Project Management Methodologies, 2015).

Table 1. Tools and methods for economic decisions

Analysis of Present Worth (PW)	The present worth of future cash flows with a certain discount rate. The project is acceptable when PW (i) > 0, but it breaks even when PW (i) = 0, and it should not be accepted when PW (i) < 0.
(ROI) Return on Investment	Indicates the profitability of choices within a certain time-frame. Priority must be given to the alternative with the largest ROI, as ROI= Net Income (Revenue-Cost)/ Investment.
Period of Payback	An essential period for recovering initial investment with the net cash flow.
Analysis of Benefit-Cost	Measures the total costs and benefits of a project alternative. Afterwards, one must calculate the ROI, Internal Rate of Return (IRR). Also, the NPV and payback period must be calculated. When the Benefit-Cost (BC) ratio > one, then it is an acceptable alternative/project.
Analysis of Annual Worth	Signifies the inflow and outflow of cash for annual equivalent values of choices at a particular interest rate. It is an acceptable revenue project if Annual Equivalent (AE) (i) > 0, and if AE (i) < 0, then the service project investment is suitable.

Primary operational management tasks feature operational-calendar production planning and systematic accounting, as well as controlling the implementation of calendar plans and the operational control of the production procedure (Grau-Moya, Ortega, & Braun, 2016). The models of operational management are typically models for analyzing the optimal lot size and the optimal schedule for releasing parts or calendar planning (Virine & Trumper, 2017).

Models of the management of technical preparation of production include the technical production preparation with the stages of design (Grau-Moya, Ortega, & Braun, 2016). Through mathematical modeling, there are three tasks to solve technical management production preparation:

1. Define the minimum term for implementing measures to technically prepare the product, while restricting the level of accessible resources (Cuéllar & Mashaw, 2017);
2. Determine the lowest cost for implementing measures for the technical preparation of production, while restricting implementation time and the level of accessible resources (Grau-Moya, Ortega, & Braun, 2016);
3. Determine the lowest consumption level for scant resources, while restricting the cost and timing for implementing technical training activities (Cuéllar & Mashaw, 2017).

Thus, technical preparation of production gives the most optimal and convenient reproduction of the network model (Haji Ali & Karnon, 2015). Furthermore, the network model helps to account for the probabilistic nature of technical preparation of production. To achieve optimization, one must use the methods of mathematical programming, particularly the simplex method, and random or statistical search (Fox, 2016).

Included with the individual models for implementing the basic functions of managing the production process is a system of interrelated production and management models. This system of models was assembled with the mathematical apparatus of set theory, graph theory, and vector calculus (Haji Ali & Karnon, 2015). According to the cumulative graph, the production process offers the output of many products, while the technological process for one product is its structural and technological graph (Haji Ali & Karnon, 2015). For resources that support production, there are many divisions of labor resources, equipment, limited components, and limited materials. A vector can describe the state of production, as it is comprised of finished products, semi-finished products, and de-aliasing units that are simultaneously produced (Cuéllar &Mashaw, 2017).

Modeling of the organizational management structures is intended to improve and optimize the enterprise management system. This step is needed for automating the management of production and economic systems, as serious preliminary work is necessary (Cuéllar & Mashaw, 2017). Also, the theory of mass service acts as a mathematical device to model organizational management structures (Haji Ali & Karnon, 2015). Simultaneously, queuing system elements are viewed as management

system elements. These elements are intended to solve a specific management task, and a priority system is premeditated in the order of the solution for all task-elements. Additionally, the qualities of the incoming flows of maintenance requirements are recognized to solve the control tasks (Haji Ali & Karnon, 2015).

Included with modeling organizational management structures with chains of elements is a method of mathematical description of the control system's organizational structure with linear stochastic networks: one of the classes of multiphase queuing systems (Haji Ali & Karnon, 2015). This model entails that information passes consecutively through some control system elements that are described with the mathematical apparatus of queuing theory. Transitions of the Markov type occur after the information goes through the network elements, and a certain graph represents these transitions. A stochastic matrix of transitions is also assembled (Cuéllar &Mashaw, 2017).

The objective function or efficiency criterion in the mathematical modeling of organizational management structures is solely explained statistically, so optimization is completed with numerical methods, such as methods of dynamic programming and statistical search (Cuéllar & Mashaw, 2017). With the statistical search method, optimization of the organizational management structures has not yet gotten the broad application for the problem under consideration, regardless of the more flexible restrictions from the efficiency criteria and the assumptions that recount this method's physics of the phenomenon (Grover, 2016).

Specifically, game modeling is considered quite special among other methods for automating the management of production and economic systems (Blokhuis et al., 2012). A unique feature of game modeling is that is involves people in developing and conducting a business game to model the management procedure. The business game involves an imitation of a group of people to resolve certain tasks of economic or organizational activities of a project, which is performed on the model of the object that is within a similar environment to the actual one (Blokhuis et al., 2012).

Formalized and non-formalized parts are included in the business game model (Warner & Méndez, 2012). Those who participate in the game actions must adhere to certain regulations that are based on instructions that are exclusive to the conduct of the game and the data of the situation (Miles, 2014). The scenario of the game allows for participants to obtain introductory information as the situation fluctuates. As participants formulate their decisions in the business game, they assess the situation to manually or technologically make any calculations (Blokhuis et al., 2012).

A production business game is the primary kind of game simulation that is held at enterprises. The goal of a production business game is improving any existing forms and developing new forms of production management, developing guidance documents, reforming production, etc. (Warner & Méndez, 2012). Network planning and management (SPM) methods that are based on network schedules are popular for conduct business games. However, methods of dynamic programming are utilized to solve planning issues, while linear programming is utilized to solve resource

allocation issues (Desai & Ganatra, 2015). Training management personnel requires an educational business game, which aims to improve the management skills of employees.

Common Managerial Decision Approaches

The managerial decision is made with different approaches, as adopting managerial decisions requires different strategies to be applied, including:

1. Utilizing hierarchy during decision-making by performing most firms to coordinate action and to strengthen centralization within management (Felder & Mayrhofer, 2017). American industries usually have managers delegate their authority for decision-making in the level that requires more information and that directly contributes to applying a certain solution (Tatić & Činjarević, 2016);
2. It is fairly widespread in America to utilize target interfunctional groups during decision-making, as these target groups are typically produced for the short-term. Any target group members are chosen from various departments and levels of government so that they can use their knowledge and experience to make complex decisions (Locatelli & Mancini, 2012);
3. To effectively coordinate actions, one can utilize formal procedures when making decisions. On the other hand, such rules can limit the management system, can delay the production of innovative processes, and can make it difficult to modify plans as the circumstances change (Locatelli & Mancini, 2012);
4. During decision-making, using spikes organizes the firm's activities. Managers spend a great deal of time planning, as it is an important role (Steimer & Douglas, 2013). Generating plans entails merging interests and goals to be carried out in different levels of government. American firms adapt control and accounting systems for management tasks while developing plans.

Basically, an American manager is more individualist than collectivist during decision-making (Cuéllar &Mashaw, 2017). Individualism is the future for the present, involving planning for perspective, forecasting, marketing, and chasing the goal. One must understand the consumer to fulfill his needs, to foresee changes in the market, and to take the necessary measures in production (Grover, 2016). American firms focus on the consumer's requests and tastes, as the consumer affects management and how the firm is organized.

In America, making decisions in the field of investment requires preliminary calculations of payback and efficiency (Virine & Trumper, 2017). With a payback or efficiency exceeding zero, any investments are considered advisable because they lead to an increase in capital (Hair et al., 2014). Also, one must consider the payback analysis and the usefulness of other alternative investment options to decide on the highest indicator.

Multiple large firms in the U.S. feature special departments or services to generate new product samples and to conduct testing (Project Management Methodologies, 2015). Furthermore, engineers, and technicians-specialists in these firms work

on production and technology, but a production engineer often manages product manufacturing under functional specialists involved in the process. The production engineer can also create a management group of specialists that can become a permanent production department.

Production departments have trouble introducing new products because implementation involves coordinating the design of the product from workers in various divisions (Tatić & Činjarević, 2016). Also, the developers often represent the customer because members of the product development group could have conflicting interests. Design engineers typically focus on making a technologically-advanced product, while producers want to reduce production cost.

The customer being involved in the development process is essential to how it performs in the market. If one monopoly firm creates the new products, then sales volumes can increase by attracting new customers, providing new products to old customers, and using old samples to attract customers from other firms with similar products (Felder & Mayrhofer, 2017). The increase of competitiveness in the firm encourages the innovation and new products, so firms are subject to commercial secrecy and are aiming to patent products right away.

Mechanism for Making Managerial Decisions

Firms can utilize a simple and a complex mechanism of interaction in management that is contingent on the intricacy of the decision-making and the implementation potential.

1. Leadership in decision-making requires a linear (general) leader who can work under a superior leader (Felder & Mayrhofer, 2017). This creates a hierarchy with extended positions, as leaders problem-solve with the immediate supervisor, instead of with higher-level managers who bypass immediate supervisors. American management typically features this method.

Also, line managers in American firms are personally responsible for their work and can discard any resources to attain the necessary results. Rights and responsibilities should be equivalent, as functional unit heads act as experts, help line managers, and report to line managers; however, they do not have the rights and responsibilities of the line manager (Felder & Mayrhofer, 2017). Before making a decision, the general manager accepts the proposals, hears opinions from immediate subordinates, and hears opinions from individual employees when they conclude collective agreements with trade unions that represent the workers.

2. The firms usually develop decision-making rules and standards by devising the actions needed to implement decisions under certain circumstances. Any rules are made to organize between different units, and they are organized into operational, strategic, and organizational (Project Management Methodologies, 2015). Furthermore, operational rules are typically created in the middle control link through various instructions.

Decision-making with strategic rules or business policy includes many aspects, such as deciding on the kinds of services to produce, the customer demographic, the arranging of the sales network, the processes for setting prices, conditions, and assurance for selling company products (Felder & Mayrhofer, 2017). Any strategic rules are limitlessly created at the top management level with contributions from middle management.

Organizational rules are rooted in local or state legislation, as they entail deciding the rationale for the firm's activities, the firm's connection to state institutions, and the firm's legal form (Turner, 2017). Furthermore, organizational rules establish the business owners, as well as their rights and responsibilities (Felder & Mayrhofer, 2017). Also, the rules establish the quantity of dividends, top manager and bonus payments, salary schemes, and investment limitations, and managers have control over the business' financial resources (Felder & Mayrhofer, 2017).

3. Plans coordinate the actions of multiple divisions when making managerial decisions, and they settle on the necessary resources to complete the goal expediently. Also, plans address production department activities, so management decisions stay within their agenda. Plans are more flexible that rules, as they easily adapt to fluctuating conditions. American businesses focus on the importance of plans, as they help to coordinate activities at large enterprises to connect strategic and operational management. Typically, annual planning in large US firms starts top management defining the standards for the production department or the profit center.

The SCC, or the production department, is the firm's lower level of responsibility to complete economic activity, such as development, manufacturing, and selling related products. Sales volume, profit, and capital investments are the planned indicators. Then, the SCC or production department arranges a detailed annual plan to foresee indicators, such as sales volume, for every product type, product income, manufacturing costs, capital investment, and employment level (Felder & Mayrhofer, 2017).

Subsequently, the production department head discusses the plan with the superior head to make a final decision. The head of the production department periodically evaluates the results of the plan (Best, 2016). Depending on the assessment, adjustments are made to the intended indicators or to specific measures, but deviations require that the management of the production department notifies the top management of the firm to make further decisions.

4. Leaders on the same level as the individual interaction accept bilateral decisions without word from the general managers. Thus, a horizontal method is implemented to organize the decision-making, while staying within the realms of approved rules and plans (Best, 2016).

During coordination, special people are allocated into production departments on an equivalent level to the management structure. The coordinator acts as the project manager in some firms, as he implements certain work and coordinates who gains authority for taking appropriate decisions (Best, 2016). It is common for the managers to be selected as the decision-making coordinator, as they develop new products that are made in various production departments. Thus, the coordinator acts as the head, as he takes responsibility for the final product and can make decisions on technology, the arrangement of production, and advertising (Felder & Mayrhofer, 2017).

5. Target groups operate from group interaction, as they make decisions based on problems in joint activities for achieving certain goals. Also, target groups can be either temporary or permanent. A head chairman is appointed as the head of the group, who can accept decisions without receiving an agreement from the corporation's top management or general manager (Felder & Mayrhofer, 2017).
6. Matrix structures differ from the other two horizontal mechanisms because the project manager has linear rights like those given to functional unit heads. There is a network structure on the rise that alleviates the decision-making process in more complex situations (Galli, 2018a; Grover, 2016).

Obstacles to Using Mathematical Models and Methods in Project Management

There are three factors that define the business market is defined by three factors, which are competition, market control, and high profitability. Projects need effective economic decision-making, as these decisions aid in maximizing ROR while minimizing the risks. Also, planning and managing resources is important with PMI, and stakeholder expectations must be noted to maintain measurable performance. Furthermore, PMI forecasts costs and experiences by comparing to previous projects, which can help to predict how costs will be affected. There can be no miscalculations when forecasts and risk assessments do not reflect past experiences, as miscalculations overvalue benefits and undervalue time and costs. Data misrepresentation is at the root of such a wrong decision, as it leads to more optimistic forecasts.

Competition, economic uncertainties, regulations, policies, and technological changes go unconsidered by traditional economic methods, so vital economic decisions need to be made during a project's lifetime. Money, time, aptitude, and other resources that rely on each other can go ignored during economic decisions. Thus, project managers need to address such doubts about ongoing economic decisions and must use rational decision-making skills. A project manager without experience is more likely to make the wrong decisions.

Once uncertainty is recognized, economic decisions become indefinite, so the risk probabilities can influence project performance. Thus, a project manager needs to recognize when to terminate, but many factors influence decisions from program managers about future strategies. In reference to Galli (2018b), it is suggested that persistence is "a sign of leadership and withdrawal as a sign of weakness," as a

project's failure is taken as a personal failure by the program manager. As a result, the program manager tries to create a successful project to validate their actions. Setbacks are viewed as temporary situations, and more money solves necessary costs; this is an updated economic decision to achieve long-term gains declaring sunk costs as unrecoverable. Program managers also refuse to accept a project's failure because this can lead to confrontation and difficulties. Essentially, program managers must adhere to certain rules and political forces that affect stakeholders and those who are independently involved.

Application to Strategic Project Management Decisions

Currently, project managers make economic decisions by having access to sufficient information, which will establish a project's financial position and will guide it to certain results. Additionally, project managers can implement economic strategies that will calculate the financial status of a project to yield the best results. Financial statements summarize company assets and liabilities in accordance with how management used their resources (Galli, 2018a). Thus, financial statements help project managers with decision-making because they ensure that the project succeeds in accordance with financial goals, which will make the project deliverables more valuable.

Economic strategies can also be defined by experience or intuition, but project managers can make errors by misusing resources, dividends, and pricing policies. The decision-making process influences the management of project limits when meeting objectives, so alternatives must be made for the decision-making process to be an objective. Thus, past decisions will define the process, which could negatively impact present and future projects.

Project managers must make economic decisions to foresee profits from their projects. These economic decisions can be made by launching new products, producing volume, establishing product cost, and selecting alternatives for the production process. Also, managers must understand the relationship between revenue, cost, and profit in order to select the best alternative. The analyses of break-even and cost-volume analyze this relationship, which produces helpful guidelines for managing the decision-making process. One can also apply the cost-benefit analysis tool during decision-making.

Planning project benefits requires an understanding of a project's cost structure. Production costs can be divided into variable and fixed costs. Though total fixed costs are not varied in volume, total variable costs are directly altered with volume changes. Approaching the break-even point means that the total revenues can cover total costs. For example, the income composition can be measured by the number of units sold and the sale price. Thus, total costs encompass both fixed and variable costs.

The equilibrium point is comprised of the minimum production level and the required sales activity that will cover the costs. Variations of the total fixed expenses, sale prices, and the unit variable cost create fluctuations in the equilibrium point. As a result, the manager will obtain valuable resources with a neutral decision-making

process by the cost analysis. This will yield helpful resources for generating a more neutral decision-making process, as well.

Evidently, there are many benefits to using the cost-benefit analysis. This analysis provides management with many strategies during decision-making, and it illustrates the basics when a new product is introduced. Additionally, this analysis aids in selecting better production processes, and it can help with analyzing the cost-volume-utility model. It is a tool that determines prices, but it also specifies the level of minimum sales to cover costs. Thus, the cost-benefit analysis contains vital information during the decision-making process, but it also aids in giving decisions for concluding or growing a project, viewing project profitability, and providing variations in the product or service.

DISCUSSION

Examples of Economic Mathematical Models in Project Management

The following examples emphasize the potential of applying mathematical models to project economic management decisions. There are three common basic economic mathematical tools, such as Net Present Worth, Annual Equivalent Criteria, and Internal Rate of Return.

Net Present Worth Criterion

It is most common for a project to be chosen from one of two alternatives. Such a decision illustrates the initial physical investment. For example, a machine may be bought once a project has initiated, but there can be various cash flows during various times with an equal quality of service. Thus, making the right decision when acquiring a project is only possible through the knowledge of how projects contribute during different stages. In the end, the present worth criterion would be helpful in the process of selecting one of the two machines.

One must make the best decision when choosing between one of the two generators in the instance that an organization has the following specifications and must purchase two separate machines. In addition, decision-making only yields the generator's net present worth analysis shown in Table 2.

Table 2. Net present worth analysis

	Machine A	Machine B
Preliminary Cost	$2,500	$3,500
Annual Operating Costs	$900	$700
Worth of salvage	$200	$350
Period	5 years	5 years

Present Worth (A) = -2,500 - 900 (P|A, .10, 5) + 200 (P|F, .10, 5) = -2,500 - 900 (3.7908) + 200 (.6209) = -2,500 – 3,411.72 + 124.18 = -5,788
Present Worth (B) = -3,500 - 700 (P|A, .10, 5) + 350 (P|F, .10, 5) = -3,500 – 2,653.56 + 217.31 = -5,936

Machine A Should be Selected Since Present Worth (B) < Present Worth (A)

However, the present worth analysis is provided by the engineering project management because businesses focus on purchasing capital goods that have a future worth that is considered economically viable. The previous analysis indicates that the present worth of machine A exceeds that of machine B. As a result, the project manager must choose machine A with this approach. In the case of capital projects, the decision-making process is in need of the present net worth. Also, the present net worth analysis must be performed during any intended purchase for any organization with the consideration of suitable choices. Solving the present worth analysis for future cash flows can exemplify the future worth of an investment that is being generated at that time (Galli, 2018b).

Annual Equivalent Worth Criterion

Applying the annual equivalent worth criterion can help when solving engineering problems and when making decisions. This criterion illustrates the financial worth for a decision that is based on the annual cash flows, and any audited operations with annual production of cash flows regularly utilize the yearly equivalent worth criterion. It is common for this type of equipment (generation plant or heaters) to be used in the engineering project. However, such equipment needs to be restructured as time passes, so the annual equivalent worth criterion can help to provide multiple options. One must consider engineering projects at the close of every financial year for future costs and budgeting to be analyzed.

Additions need to be made if a business offers utility services, such as on feed water, to improve the efficiency of systems and to reduce the cost and use of fuel. The unit of 150-MegaWatt is indicated with a cost of $1,650,000, and it has a 25-year lifetime value. However, the salvage value is insignificant, so installing the second unit can increase efficiency by 1% (a change of 55% to 56%). At $0.05 kilo-Watt-hour, it is anticipated that fuel cost and the cost of running the feed water will remain the same. Additionally, the load factor will run at 85% of the year, and such projects typically contain seasonal factors. Thus, the annual equivalent worth can help to generate the most favorable decision for future annual project costs, and it is evidently valuable when compared to the current system.

However, a project can still have repeated cash flows, such as when an energy-producing company can provide a nearby utility with solar energy. One must consider the variable during the selection of alternate silicon cells for a project, but the preliminary investment of solar cells, as well as the degradation cycle, are both lower. Since new cells must be bought over time, one must calculate the annual equivalent at the interest rate for the project to receive the green light. Overall, the annual equivalent worth criterion can determine a project's economic viability.

The Internal Rate of Return Criterion

The engineering management field takes more than just one venture, project, or product into consideration. Managers experience various new investments and make plans for building a business. When deciding on a project, the Net Present Worth (NPW) criterion is usually utilized. Furthermore, NPW illustrates the amount of money that will be received by the investment, even though it can be insignificant. By applying the internal rate of return, the first worth of the project will be intuitively evaluated to demonstrate the amount of investment that will be gained during an indefinite period of time. Eventually, the importance of the rate of return will be known, as well as the amount of time that a company needs to have full gains. The rate of return is also vital for side projects that offer various capital sources. Since projects are viewed as sources of revenue to groups, predictions help to produce new strategies and approaches.

When a business takes new technologies under consideration that will meet the product and customer needs, the internal rate of return criterion must be used. Deciding on a new technology can influence the quality of the procedure, as the rate of return must be considered because there must be a new investment. Businesses have specific Minimum Attractive Rate of Return (MARR) values that calculate a project's rate of return for the project, but the project will only be successful with an equivalent or higher rate of return is equal than the MARR of the business.

Decision-making with the internal rate of return is exclusive to the nature of the project, as it varies depending on the situation. When a real investment project yields a different calculation for the internal rate of return through NPW mathematical expression, the business will compare it to the MARR. If the rate of return exceeds the MARR, then the project's success is clear.

There will be a difference between the cash flows and the rate of return if there are mixed investment projects. Such an instance occurs when a business purchases equipment for multiple uses at multiple periods of time. Thus, there is an insufficient internal rate of return because the project cannot be monitored. Also, the project cannot produce viable economic decision-making, so one must calculate the external rate of return. This necessitates using all internal rates of return to calculate and compare the MARR with the present external rate of return.

Furthermore, the internal rate of return applies when a project manager must select one of two similar projects that have different cash flows. As a result, it is solely for investment to calculate the internal rate of return. Also, it is for mixed investment to calculate the external rate of return, as both rates of MARR can be compared to yield a choice. The selected project must generate a rate of return that exceeds the MARR to illustrate that it is economically viable. Businesses could gain a great deal of help and resources if they foresee different returns on projects. Also, this is applicable to businesses that ensure a higher rate of return.

Cost Concept Relevant to Decision-Making

Financial statements can be preserved by the cost classification process. Sometimes, project managers need information about how an operation's changes will affect the

cost of a different operation. The general project cost fluctuates with the change of any other aspect of a project; thus, each aspect within a project environment is connected. If a project manager requests data on changes based on employee salaries that have a 10% production increase, then the variables are related. The production increase may reflect that the manager went ahead of another criterion. The manager may not have considered aspects, such as employee salaries, so this increase throws the profits from the increase in sale off balance. As a result, the salary could increase more aspects other than finances. This method is clearly beneficial during decision-making about the project life cycle or project environment.

Additionally, this concept is pertinent because future costs cannot be determined by the historical trend and previous project costs. However, the previous record is still helpful to establish future costs because the historical data is needed to predict future costs. Other costs, such as opportunity, sunk, and differential costs, serve as the practical measures for engineering projects. These other costs establish future costs that relate to an operation or decision. Also, the cost analysis and classification method is applied to the operating income, manufacturing budget, preservation of sales, and real budget.

The cost concept is another method for making viable decisions. Furthermore, costs must sustain a certain level to yield the most efficient capital utilization. Also, opportunity and sunk costs need to be maintained within a level that does not obstruct other costs, which must be understood by engineers. Costs will be assigned within controllable levels for a project to function within the levels of return that are needed.

Main Reflection of Findings

Economic decision-making is an aspect of everyday life. People are always making different decisions without considering why some are more successful than others (Avram et al., 2010). Intuition and everyday experience are not used when solving complex management tasks in the economy and in social life. Instead, accurate calculations and an analysis of the problems are done. To discover how specific economic decisions are made, one must consider the basic principles of economic activity that are linked to society's limited resources. This analysis exposed numerous models in economic decision-making, which illustrates the inevitability of traditional models being replaced with mathematical models. A primary finding is that decision-makers are considered rational. In reference to the economy, rational is defined as a decision or action when the marginal utility or the benefit from using an additional/marginal unit of consumption that will be more beneficial than applying the resource's marginal (Avram et al., 2010). As a result, resources will serve as producers of benefits until their additional units are more beneficial than the price of obtaining them. In certain situations, the lowest values that economists work with are the marginal benefits or costs.

This practice should be followed by all subjects that act rationally, as the future is usually considered by economic decision-makers. No one can know the future, so one can only assume what it will entail, as the most important hypothetical methods to

predict the future are through probabilistic (Avram et al., 2010). Probabilistic methods are rooted in statistical interpretations of both previous current events, which are followed by the rational assessment of their application in the future. All probabilistic forecasts are constructed, but business entities should evaluate their assumptions up against real results when making economic decisions about the future. Thus, economic decision-makers can learn from deviating from assumptions with reality to learn from their mistakes, as probabilistic assessments are dependent on adaptive opportunities when the economic entity presumes that the same development tendencies from the past will reoccur (Avram et al., 2010). The economic decision-maker and the influence on future events can use rational expectations to influence their assessments when the subject can consider the penalties of previous decisions.

Critically analyzing these penalties can lead to an adjustment of any decision-making. In reality, the unpredictability of the future is considered by producing insurance stocks to reduce or eliminate damage when things go bad. This purpose also applies to the activities of insurance companies and societies that must pay for the damage to insured persons, businesses, and firms through insurance premiums (Nelyubin & Podinovski, 2014). Uncertainty can also be addressed by avoiding risks if there is a high probability that probability unfavorable developments will occur. This is most apparent when investing capital, particularly when foreign companies will not invest in an economy of a developing country. Lastly, uncertainty can be accounted for by maximizing resource savings and by minimizing costs. This is known as the economy mode, and these savings allow one to economize on resources for unexpected future events.

Implication of the Study in Engineering Management and Project Management

The primary implication in the Engineering Management & Project Management (EM/PM) study is that there will be more specificity in the future of decision-making in PM. Furthermore, decision-making will be based on evidence and will remain unbiased, which can be understood by reflecting on what decision-making has been like. Both statistical and econometric methods are linked to mathematical research methods, as well as economics and management (Nelyubin & Podinovski, 2014). These methods predict scientific and technological progress, but they mostly predict non-numerical data and expert estimate statistics without the use of modern statistical methods. Additionally, people cannot part with the solution of multiple problems of standardization, and this study's findings indicate that adopting the proposed mathematical models will lead to better decision-making processes in the future.

An additional implication is that most economic problems can be addressed by adopting these economic decision-making models. The reason for this is that each country's economic activity is comprised of many economic entities: individuals, enterprises, firms, and companies, etc. (Nelyubin & Podinovski, 2014). As a result, the decisions are taken along with economic policies and real government decisions.

Ultimately, this will establish the successes and failures in meeting the country's living standards.

Application of the Findings in Engineering Management

In a project environment, one can apply these proposed models and methods to risk management and preparation for future economic decisions. It is common for unforeseen circumstances to arise in management activities, and extraordinary actions associated with risk are often required. Any arising problems, as well as associated risks that occur from their decisions, can have natures that are explicit and implicit (Nelyubin & Podinovski, 2014). Essentially, everything is dependent on incoming information, as it is more definite in the first case, but it is a weaker warning of danger in the second case. No warning signs should go ignored, as they should all lead to stronger scrutiny of events. Making a decision in conditions of certainty or reliability increases the speed of development, as well as reducing the costs of selecting a viable alternative. In this situation, it is advantageous that the management entity enters all variables for calculations under the same objective conditions. It is uncommon in practical work for there to be complete certainty, so its elements are from the degree of certainty in the general context. Introducing probabilistic estimates when a decision is made under risk or measurable uncertainty will significantly reduce uncertainty. Also, one can anticipate variations in the variables distinguishing the state of objective conditions, and the risk is made up of potential errors in evaluating the probability of conditions or events. Thus, experience, intuition, the art of the leader, and calculations are all relied on. Such qualities are essential in determining the likelihood of events occurring in conditions of uncertainty (Nelyubin & Podinovski, 2014).

Implications for the Field of Project Management

As seen in the analysis, decision-making tools play a very particular role in strategic planning. In reference to foresight, decision-making necessitates strategic and financial information from the planner or decision-maker, which makes the decision essential to the business' vision. In the literature review, it is apparent that the industry uses highly sophisticated methods, despite the qualitative nature of managing foresight. Furthermore, one must commit a great amount of time and resources to foresight for it to be successfully implemented. The second element of the research question involves that there was no evidence in the literature on the efficiency of these decision-making tools. Thus, one must follow-up on those projects to establish their effectiveness.

Decision-makers have been struggling with economic decision-making, as the environments are always changing. Decision-making quality suffers in the case of constantly shifting external factors, so one must recognize how much drivers of external change impact decision-making. It is worth studying how decision-making tools affect strategic planning because organizations and policymakers can greatly benefit. On the other hand, the research illustrates foresight and other related concepts are not given sufficient examination by academia. It is possible that industrial engineering

and project management should help to develop curriculums to provide support and further development for foresight and other concepts.

This study is pertinent to engineering management, as it offers information about the future of economic decision-making in project management methods. Additionally, this study confirms that economic decision-making entails decision-making systems that support a business' strategic planning. Economic engineering can utilize the advances in this study in future scenarios, as using financial analysis tools and qualitative forecasting tools can positively affect decisions about strategic investment.

Barriers to Decision-Making and Strategic Planning

The primary difficulties in decision-making that supports the business' strategic vision are insufficient information, varying priorities, and the impact of resources on decision-making. A lack of information is linked to the experience of the decision-maker, the knowledge management structure, and the business' culture. Collecting lessons learned can be cumbersome on a company's resources, so the relationship between uncertainty and resources affects the quality of the decisions. As a result, available resources have negative impacts on how managers use decision quantitative and qualitative criteria during decision-making situations.

CONCLUSION

In the past, innovativeness and economic decision-making are not viewed as priorities in project management. Thus, there has been a low success rate because the economy's influence on a project entails transactions (Haji Ali & Karnon, 2015). In the data, innovativeness and economic decision-making illustrates how innovativeness has been disregarded in past projects, as there has been a low success rate in projects. Innovativeness is vital for guiding a project to success because of competition and the dynamic nature of problems, so new ideas can transform the present and can improve the future (Grau-Moya, Ortega, & Braun, 2016).

Making suitable economic decisions necessitates analyzing economic conditions with economic models to grasp the standard economic conditions in the present. Having knowledge of the economic situation in advance can lead to more accurate planning, as it would address future weaknesses from potential opportunities (Turner, 2017). Once the conditions become more predictable, project strategies can become more prepared, which supports the conclusion that suitable economic decisions from proper analysis enhance a project's success rate (Haji Ali & Karnon, 2015).

Evidently, a project's success is dependent on economic decision-making in project management, so this relationship illustrates how accurate analysis impacts the success of a project (Haji Ali & Karnon, 2015). No one can control change, which is why making the appropriate forecast can ensure the precision of previous economic knowledge (Blokhuis et al., 2012). If conditions can be predicted, then there can be conformity, accuracy, and relevance within the project strategies.

It is important to address a problem with innovation because change elicits plausible solutions to supervise the multi-faceted nature of situations, and it effectively addresses the problems (Blokhuis et al., 2012). Also, effectiveness could be in regard to cost or ease, which makes it vital for innovativeness to be a primary focus of research. Project management teams must brainstorm and critique methods to generate possible solutions (Haji Ali & Karnon, 2015).

The problems of risk and the size of the directorate are insignificant; proper analysis and the quantifying of risks can eliminate risk (Grau-Moya, Ortega, & Braun, 2016). As a result, risk does not affect a project's success rate, as this is mostly dependent on the measures that can combat limitations derived from risks (Blokhuis et al., 2012). Also, the mitigation of risk is contingent upon innovation, as well as the level of economic analysis completed prior to economic decision-making. A guarantee of suitable economic analysis can greatly decrease how much risk influences project success (Haji Ali & Karnon, 2015). Additionally, the decision should be innovative, as it contains new methods for addressing problems that arise. One should emphasize the methods that are used to mitigate the risk, so project managers must reduce any uncertainties by assigning probabilities to analyze the effect and to address the plans (Project Management Methodologies, 2015).

Numbers should be less emphasized than qualifications and experience. According to the results, quality is what should drive a project, rather than quantity. A few individuals should steer a project, as they should have the proper qualifications, attitude, and aptitude for teamwork for higher success rates (Virine & Trumper, 2017). One should approach the management team size with caution, as it should rely on the associated costs. Essentially, a few experts in an enabling environment would be sufficient in delivering in comparison to many non-experts in the field (Haji Ali & Karnon, 2015).

Within the model, there is innovativeness, as well as economic decisions from independent variables. The model's high prediction ability illustrates that the project success rate is mainly linked to innovativeness and financial decisions, as project success in linked to innovativeness and accurate economic decisions (Haji Ali & Karnon, 2015). In the condensed regression model, the value of R squared equals 0.809885. Innovativeness and economic decisions account for about 81% of a project's success, which substantiates the importance of good economic decision-making.

Overall, project managers should make certain that suitable economic decisions are made with innovativeness (Turner, 2017). Furthermore, the research indicates that decisions must be innovative to account for the anticipated future (Haji Ali & Karnon, 2015). Future predictions must be comprehensive, so as to not recommend something for a non-existent condition. Probabilities and uncertainties about the project can guarantee that research factors are seen within all aspects of the project (Blokhuis et al., 2012). The future will highlight economic decision-making in projects because it is essential for project success.

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