*Ann Appl Sport Sci,* 12(01): e1236, 2024.
http://www.aassjournal.com; e-ISSN: 2322–4479; p-ISSN: 2476–4981. 10.61186/aassjournal.1236

ORIGINAL ARTICLE

# Execution Requirements Time-Driven Design-to-Cost Method to Achieve a Competitive Advantage

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**Submitted July 23, 2023; Accepted in final form September 29, 2023.**

## ABSTRACT

**Background.** All industrial companies aim to achieve a competitive advantage by defining customer wants and rethinking development processes to meet those wants at an ideal cost and acceptable quality before the physical formation of the product. This is accomplished by coordinating the customer's wants with the quality of the required design in light of the industrial target cost. Which necessitates assembling a design team that has engineers and accountants to deal with all data pertaining to resources, alternatives to those resources, and ways of assigning indirect expenses, which make up the bulk of the overall costs. **Objectives.** The aim of this study is to demonstrate the role that design-to-cost technology provides in the process of comparing resources to create a product that meets the needs of the customer, as well as the role of time-driven activity-based costing technology in the process of determining activity costs for the purpose of accurately allocating indirect costs. The goal of the time-driven design-to-cost technology is to build a database of information on the costs of alternatives and the actual operating time of the product to be designed to provide appropriate information for the design team. **Methods.** The study approach focuses on the deductive and inductive approaches to reviewing the research and literature that dealt with my technology, Design-To-Cost, Time-Driven Activity-Based Costing, as an attempt to build a conceptual framework through which a database can be built that can be used by the design team in industrial companies for the purpose of determining the design cost of the product before it actually enters the production process. **Results.** The percentage weight of the response intensity of the sample was 85.91%, with a weighted arithmetic mean of 4.36, a standard deviation of 1.02, and a variation of coefficient of 20.79%. As the highest paragraphs that contributed to the promotion of this variable are TD-DTC contributes to accurate cost measurement by identifying the time of arrival of value-creating activities. as its weight percentile was 98.25% with a weighted arithmetic mean of 4.7 and a standard deviation of 0.428 against a coefficient of difference 11.87%, while the lowest percentage in these variables was for the TD-DTC technology provides an efficient solution to the problem of identifying customer needs at an optimal cost. paragraph as its weight percentile was 74.88% with a weighted arithmetic mean of 4.2 and a standard deviation Its value is 1.791 against a coefficient of difference 30.92%. **Conclusion.** We can conclude that building a technology on two pillars, cost and time, makes it much easier to create a product that is valuable to both the company and the user, given the intended manufacturing cost. Cost accountants should be brought in during the design stage to help the design engineers understand this information so that energy and resources can be saved and the company gains a unique competitive edge over its rivals.

**KEYWORDS:** ***Design-To-Cost, Time-Driven Activity Based Costing, Time-Driven Design-to-Cost.***

## INTRODUCTION

Many international companies aim to control competition by adopting a policy of innovative product development. To accomplish this, it is necessary to develop the product's design process to have the features the customer wants (1). Time-Driven Design-To-Cost (TD-DTC) technology is

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widely used in many large industries that need detailed product design because it suggests optimal solutions within time frames and allows for the joint development of product structure and production strategy (2). TD-DTC gives an indication of how to represent the physical product structure as well as the organizational structure of the production system, which leads to cost rationalization, increased competitiveness, and higher profits (3). A big part of developing and making a product is making sure that the design takes cost and time into account. Because the current ways of adding cost to design require knowing the cost and time of the real parts that will be used in production (4).

The US Department of Defense has been using design-to-cost (DTC) since 1969 (5). At the same time, they have been using simultaneous engineering technology to make their war weapons, which at the time was a knowledge change in the field of non-sequential design (6). John Foster, a doctor of military strategy at Lockheed Martin, says that it is not clear that there is a straight link between a specific person and the DTC idea (7). But during this time, there was a pressing need for a combined database that would help creators build and keep track of the link between quality and cost before the product was made (8). The DTC technology helps in two main areas (9). The first is the functional stage of design, and the second is cost measurement systems for all direct and indirect elements (10). The goal is to close the large gap that used to exist between accurate cost information and the designers' need for it in a timely manner (11). This will be done by removing the designers' isolation from information (12). Second, give makers the tools they need to get accurate information about how much new parts will cost (13). Lastly, the power to bring together different kinds of information for different purposes DTC is a modern technology that models how the design and cost of a system change over time (1). It does this to find a more realistic way to control costs and make sure that the product meets customer needs (14). DTC tries to find a better balance between performance and cost by providing a good method for measuring product costs accurately from the design stage (15). This is because the design stage gives a clear picture of the capacity of production processes and how well they work (10). DTC technology cuts down on resource costs by separating activities into those that add value and those that don't (13). Activities that don't add value to the product or the customer can be left out, which gives companies new ways to solve problems related to design and figuring out how much time and money to spend on each product unit (1). This helps companies find the best answer quickly and before production begins (16). DTC technology gives tools for combining cost and performance measures during design and before manufacturing or product development (17). Since the cost of the real parts that will be used in production needs to be known for the current ways of adding cost into design, the following steps must be taken: First, look at the signs of the goal cost to find a way to lower the target cost (11). Second, making a cost model based on the strategy plan to reach the goals Third, what are direct costs and secondary costs? (7) Fourth, putting together a database based on different cost factors V. Look at the prices for each person. Lastly, look at and judge the effects (8). Traditional cost measurement systems were common until the 1980s. However, as technology changed and improved, they became less useful because the information they gave managers wasn't complete or reliable enough to help them make good strategic and operational decisions (18). This is because the traditional systems relied on size in the indirect cost allocation process. Early in the year 1997, Anderson showed how a new system called Time-Driven Activity-Based Costing (TD-ABC) could be used in some North American companies (2). Anderson & Kaplan then showed how TD-ABC could be used as a revolutionary method for allocating costs (4). By putting the cost of resources directly on the cost vectors, this technology aims to make it easier and cheaper to set up and maintain distribution systems that have been used in the past (3). So, the new way of doing things helps come up with ideas and quick answers to the problem of how to divide up extra costs (19). With TD-ABC technology, time-based cost drivers take the place of quantity-based cost drivers since time is a direct cost driver (20). Taking into account that resources like people and tools have powers that can be easily measured by the amount of time available to finish the job The TD-ABC philosophy is based on four foundations (21). The first is the activity, which is the collection or linking of operations to reach a specific goal, which is represented by putting together the final product (22). These activities are measured in absolute time units (seconds, minutes, or hours), which is the amount of time it takes for a specific activity to perform a specific operation (23). Second, the major reason why costs happen in cost clusters is because of cost vectors (24). So, it is an important factor that affects how much costs go up or down, so the tasks need to be carefully looked at (25). When figuring out how much something costs, the cost wave is the starting point (26). Without it, you can't figure out how much something costs for any goal or reason (27). Third, what makes time go by? The time rates are one of the most important parts of the TD-ABC opening (28). These are factors or events that decide how long it takes to do an action, which is shown in the different functions (29). Time is seen as the main factor that affects costs, since the total time needed to do a certain task is found by adding the normal time and any extra time needed to do the task (2). Fourth, a time equation is a scientific way to show how long it takes to do something. It assumes that the time it takes to do an activity is not set, so it describes the time it takes to do the activity as a function of a few vectors (30). This makes the description more objective and less complicated. Companies can easily use and change the time equations because they are flexible and improve the performance of the TD-ABC input without making it hard to figure out how to allocate secondary costs (31, 32). As the number and variety of tasks go up, these calculations can change all the time (33). A marketing expert (Mono) agrees that the design of a watch has many communication functions that help customers judge the quality of a brand's product based on how elegant and beautiful the design is (8). It also helps bring in new customers (24). The design's beauty and grace can't be separated from its high cost, which needs to be kept in check from the beginning (20). The design itself doesn't cost more than 5% of the total amount. whereas the formation of the product's conceptual design sets a percentage (60–80%) of its conceptual costs, which can be avoided with the new method (10). This method is different from the traditional target cost because it solves three main problems: how to include the details of important parts in the design process, how to compare product parts and their costs, and how to make design decisions that help reach goals based on detailed alternatives (1). Time-Driven Costing (TD-DTC) is an effective way to deal with these problems so that customer needs can be found and development methods rethought so that these needs can be met at the best price (13). TD-DTC combines financial and non-financial time-oriented information to help business managers make profitable choices based on the changing level of competition, the variety of markets, and the variety of customer happiness levels (7). Many of the things that companies need to know to correctly measure prices have to do with figuring out how long it takes to get to value-adding activities, how happy customers are, how much energy is wasted, what the product's main and secondary functions are, how big it is, and how much it uses indirect resources (4). When DTC and TD-ABC systems are put together, secondary costs can be assigned correctly (18). The product's conceptual design team should be made up of a group of design engineers and cost accountants (3, 17). Their job is to build a record of all the different ways to deal with the costs involved in the product's conceptual design (29). Direct materials are easy to track and figure out their costs for the cost goal in a cost-effective way (34). They also make it easy to figure out the share of the product because there is a direct link between the materials used and the products made by the company (35). Straight pay The widespread use of advanced production technology and the automation of production processes led to changes in the cost structure (36). As production times went down, production went up by a large amount, and production processes were made more efficient to improve quality and lower the cost of direct labor (30).

In today's manufacturing environment, general costs make up a large portion of the total cost of the product (37). Some of these costs are related to indirect materials and indirect wages, and there are also many fixed costs that are hard to link directly to the cost objective (38). This means that many tools and methods are needed to measure product costs more accurately by using time as a basis for allocation (33). Figure 1 shows TD-DTC wants to make a list of possible options, the quality needed, and the amount of time needed to make the product based on six steps (1, 16, 17):

Step 1: Figure out how much each group of tools will cost all together. To determine the costs of the materials and their options, all the workers who contribute to this activity must complete the direct and indirect tasks. For each action, you have to figure out how resources are used.

Depending on what kind of resource pooling it is, all or some of these things may be involved.

Step 2: Figure out how much power there is. Most of the time, the actual energy for each group of resources is estimated to be between 80% and 85% of the theoretical energy. This is based on the assumption that the remaining percentage is kept as a reserve for losses that happen because of things like breakdown time, maintenance and repair, and schedule changes, which are called bottlenecks. It stops a particular action from reaching its goals.

Step 3: Change the cost per unit to real energy. Divide the total prices of the group of tools that have been chosen for the task. The real energy used for the group of resources, which is measured in units of time (hour, minute, and second), is used in Step No. 2 to get the hypothetical unit cost.

Step 4: Figure out when to do each task. Using time equations, the time needed for performance must be figured out based on the different time factors. This is how the time equation for the mental result is found.

Step 5: Figure out how much each action will cost for each option. By adding the amount of time it takes to complete the task, one can calculate it. Here, we get the real energy cost of finishing each option to get the total cost of the idea.

Step 6: Accept or turn it down. From the point of view of the integrated design team, TD-DTC is fine if the product's initial design meets the design goal cost. If not, the suggested design should be redone with new ideas and designs or kept the same to make a good product, which is called "Value To Design."

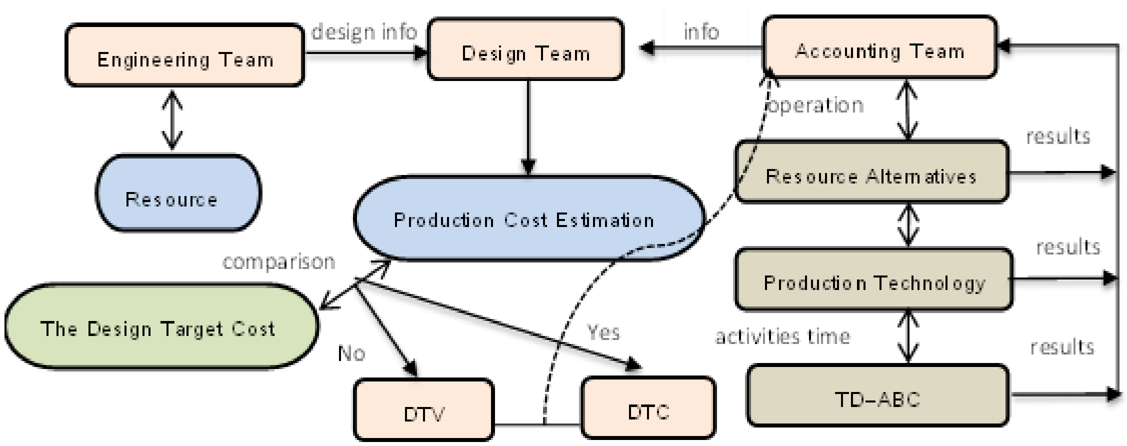


**Figure 1.** The time spent looking at the results.

## MATERIALS AND METHODS

**Design.** The current research is applied, and its purpose is a type of Exploratory study.

**Participants and procedures.** The current research community includes The administrative and scientific cadres at the University of Kufa are holders of a doctorate and a master's degree in accounting and business administration.

**Instrument.** In the current research, all data related to direct and indirect costs was collected, as well as the times that add value to the product and customer, through which my technique can be applied. design to the cost and time-driven activity-based Costing to achieve integration to reach time driven design-to-cost technology.

## RESULTS

Using the data presented in Tables 1, Table 2, and Table 3 the results indicate that Time-Driven Design-To-Cost can be used to achieve appropriate results for all design activities and events delivered by an integrated team of engineers and accountants to gain a significant competitive advantage. This means that the statistical data support the theoretical model of the study. Further support for this assertion can be seen in the results tables, which provide further evidence. In the next section, we will consider statistical indicators in general. Based on the results of the preliminary study (Table 3), it can be concluded that all current points of view strongly support the TD-DTC technique.

**Table 1. The Statistical results of Design-To-Cost philosophy**

| Paragraph DTC | Statistics indicators | | | | |
|---|---|---|---|---|---|
| | Arithmetic mean | standard deviation | Variation coefficient | percentage weight | T counted |
| DTC technology contributes to providing accurate cost information to meet the needs of designers at the right time. | 4.3 | 0.657 | 15.65% | 92.41% | 13.93 |
| DTC provides the appropriate tools to provide designers with appropriate information about the cost of proposed new parts. | 4.4 | 0.496 | 11.45% | 99.99% | 20.45 |
| DTC is a contemporary technology that simulates the design and cost system under changes to create a more realistic path. | 4.2 | 1.089 | 25.94% | 83.7% | 8.91 |
| DTC provide a clear vision of the capacity of production processes and operational efficiency. | 3.8 | 1.910 | 32.01% | 65.58% | 4.70 |
| DTC technology contributes activity analysis to activities that add value and activities that do not add value. | 4.1 | 0.849 | 20.62% | 89.89% | 9.78 |
| The overall rate of DTC technology | 4.2 | 1.002 | 21.13% | 86.31% | 11.55 |

**Table 2. The Statistical results of Time-Driven Activity Based Costing philosophy**

| Paragraph TD-ABC | Statistics indicators | | | | |
|---|---|---|---|---|---|
| | Arithmetic mean | standard deviation | Variation coefficient | percentage weight | T counted |
| The TD-ABC technology makes it possible to measure the unused energy. | 4.4 | 0.707 | 14.98% | 93.31% | 12.96 |
| Time drivers help generate ideas and early solutions to the problem related to indirect cost allocation. | 4.8 | 0.526 | 12.11% | 100% | 21.54 |
| This technology aims to simplify and reduce the cost of the implementation and maintenance of the allocation systems. | 4.6 | 1.201 | 24.98% | 84.31% | 14.81 |
| TD-ABC technology is in line with technological developments and advancements. | 4.0 | 1.891 | 33.51% | 64.98% | 6.77 |
| TD-ABC technology provides complete and reliable information. | 4.3 | 0.937 | 21.41% | 86.99% | 10.88 |
| The overall rate of TD-ABC technology | 4.42 | 1.05 | 21.39% | 85.91% | 13.39 |

**Table 3. The Statistical results of Time-Driven Design-To-Cost philosophy**

| Paragraph TD-DTC | Statistics indicators | | | | |
|---|---|---|---|---|---|
| | Arithmetic mean | standard deviation | Variation coefficient | percentage weight | T counted |
| TD-DTC technology drives design decisions based on detailed alternatives to time and cost. | 4.5 | 1.037 | 20.91% | 85.45% | 9.98 |
| TD-DTC technology provides an efficient solution to the problem of identifying customer needs at an optimal cost. | 4.2 | 1.792 | 30.92% | 74.88% | 8.79 |
| TD-DTC contributes to accurate cost measurement by identifying the time of arrival of value-creating activities. | 4.7 | 0.428 | 11.87% | 98.25% | 22.41 |
| TD-DTC technology realizes the possibility of analyzing the primary and secondary functions of a product before manufacturing. | 4.4 | 1.017 | 25.11% | 83.30% | 13.09 |
| TD-DTC technology aims to build a database that includes all the cost alternatives involved in the formation of the product conceptually. | 4.0 | 0.816 | 15.18% | 86.52% | 13.74 |
| The overall rate of TD-DTC technology | 4.36 | 1.02 | 20.79% | 85.68% | 13.60 |

## DISCUSSION

Table 1 demonstrates that the percentage weight of the response intensity of the sample was 86.31%, with a weighted arithmetic mean of 4.2, a standard deviation of 1.002, and a variation coefficient of 21.13%. As the highest paragraphs that contributed to the promotion of this variable are DTC provides the appropriate tools to provide designers with appropriate information about the cost of proposed new parts, as its weight percentile was 99.99% with a weighted arithmetic mean of 4.4 and a standard deviation of 0.496 against a coefficient of difference 11.45%, while the lowest percentage in these variables was for the DTC provides a clear vision of the capacity of production processes and operational efficiency paragraph, as its weight percentile was 65.58% with a weighted arithmetic mean of 3.8 and a standard deviation of Its value is 0.964 against a coefficient of difference of 32.01%, and despite that, we find that all percentile weights have exceeded 85%, in addition to the fact that the arithmetic mean has exceeded the hypothesis mean of 3 and a significant significance of (0.05) for all the variables of the second hypothesis. As for the t-test for the sample of the variables of the hypothesis, at a level of significance 0.05 and with a degree of freedom 55, we find that the general average of these variables calculated has a value of 11.55, which is greater than the tabular value of t, which amounts to 1.671, which makes it possible to accept the technology.

Table 2 demonstrates that the percentage weight of the response intensity of the sample was 85.91%, with a weighted arithmetic mean of 4.42, a standard deviation of 1.05, and a variation coefficient of 21.39%.As the highest paragraphs that contributed to the promotion of this variable are Time drivers help generate ideas and early solutions to the problem related to indirect cost allocation, as its weight percentile was 100% with a weighted arithmetic mean of 4.8 and a standard deviation of 0.526 against a coefficient of difference 12.11%, while the lowest percentage in these variables was for the TD-ABC technology is in line with technological developments and advancements paragraph, as its weight percentile was 64.98% with a weighted arithmetic mean of 4.0 and a standard deviation of Its value is 1.891 against a coefficient of difference 33.51%, and despite that, we find that all percentile weights have exceeded 85%, in addition to that, the arithmetic mean has exceeded the hypothesis mean of 3 and a significant significance (0.05) for all the variables of the second hypothesis. As for the t-test for the sample of the variables of the hypothesis, at a level of significance 0.05 and with a degree of freedom 55, we find that the general average of these variables calculated has a value of 13.39, which is greater than the tabular value of t, which amounts to 1.671, which makes it possible to accept the technology.

Table 3 demonstrates that the percentage weight of the response intensity of the sample was 85.91%, with a weighted arithmetic mean of 4.36, a standard deviation of 1.02, and a variation coefficient of 20.79%. As the highest paragraphs that contributed to the promotion of this variable are TD-DTC contributes to accurate cost measurement by identifying the time of arrival of value-creating activities, as its weight percentile was 98.25% with a weighted arithmetic mean of 4.7 and a standard deviation of 0.428 against a coefficient of difference 11.87%, while the lowest percentage in these variables was for the TD-DTC technology provides an efficient solution to the problem of identifying customer needs at an optimal cost paragraph, as its weight percentile was 74.88% with a weighted arithmetic mean of 4.2 and a standard deviation of Its value is 1.791 against a coefficient of difference 30.92%, and despite that, we find that all percentile weights have exceeded 85%, in addition to that, the arithmetic mean has exceeded the hypothesis mean of 3 and a significant significance (0.05) for all the variables of the second hypothesis. As for the t-test for the sample of the variables of the hypothesis, at a level of significance 0.05 and with a degree of freedom 55, we find that the general average of these variables calculated has a value of 13.60, which is greater than the tabular value of t, which amounts to 1.671, which makes it possible to accept the technology.

## CONCLUSION

Modern companies use a specific model to figure out how much it will cost to finish a product, even though there is no general agreement about how hard it is to figure out the direct costs of supplies and workers. The main problem is with the ways of assigning secondary costs for giving information and meeting management needs, which change a lot from day to day. The steps of the TD-DTC theory are meant to create a mental link between the cost of designing something and the time it takes to do it, all within a set production cost. The cost measure is a key part of the design, and the design goal cost can be used to decide whether or not to accept the design. This means that the costs of time and resources must be matched. TD-DTC is based on a series of steps that are done in order. These steps are meant to make sure that the design information and cost information for all of the parts that make up the product and their alternatives are compatible. This gives designers a clear picture of alternative resources, costs, and the required level of quality. DTC helps give the best possible result before production by coming up with new ways to solve all problems linked to product design. Only design engineers can understand the information that the DTC technology gives them, and it's not complete. This is why it's important to find a way to account for costs that takes into account the different ways to build a product in terms of cost, quality, and time, which is what the TD-ABC technology does. The new TD-DTC model strikes a better balance between performance and cost by using time as a base for calculating indirect costs from the product's basic design stage onward. This method is a good way to measure costs in an objective way. The design engineers and managers on the integrated design team know what activities add value and what activities don't, and they leave out the ones that don't add value to the product or the customer. Figure 2 shows that using the time measure as a base for allocating secondary costs will make TD-DTC irrelevant to product development. This is because the product life cycle and time scales will be shortened, costs will go down, and products will be made to fit customer needs.

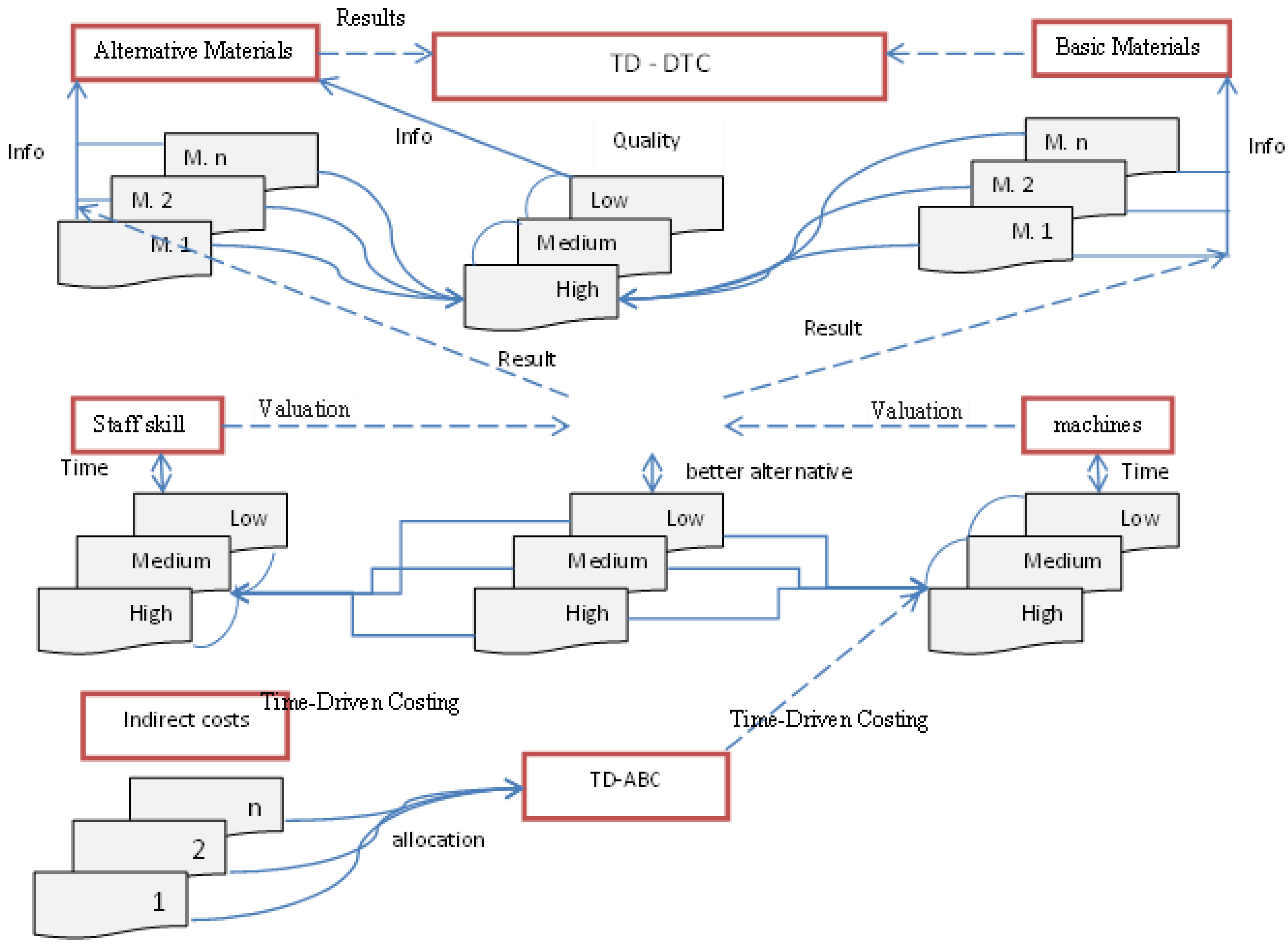


**Figure 2.** The Integration of technical DTC and TDABC.

## APPLICABLE REMARKS

- The TD-DTC technology provides a database whose information can be used in the strategic management of costs, in order to achieve the possibility of reducing costs from the conceptual design stage of the product.

## ACKNOWLEDGMENTS

Acknowledgments to all researchers and writers interested in topics that address strategic cost management. With the aim of solving all the problems and difficulties related to the objectivity of allocating indirect costs.

## AUTHORS' CONTRIBUTIONS

Study concept and design: Ahmed Maher Mohammad Ali. Acquisition of data: Ahmed Maher, Mohammad Ali. Analysis and interpretation of data: Ahmed Maher, Mohammad Ali. Drafting the manuscript: Marwah abrrahim Alshabbani. Critical revision of the manuscript for important intellectual content: Ahmed Maher, Mohammad Ali. Statistical analysis: Ahmed Maher, Mohammad

Ali. Administrative, technical, and material support: Marwah abrrahim Alshabbani. Study supervision: Marwah abrrahim Alshabbani.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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