Journal of Data Acquisition and Processing
ISSN: 1004-9037
https://sjcjycl.cn/
DOI: 10.5281/zenodo.776493

A STUDY ON CIVIL ENGINEERING RESEARCH NEEDS IN THE AREA OF TRANSPORTATION

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Abstract:
When developing the curriculum, consideration was given to the knowledge, data, and discoveries required by the engineering profession in the future. These are the kinds of things that may be generated most effectively via intentional study. The purpose of this study is to make public a declaration of the current and near-future research requirements about the civil engineering components of transportation, and it has been created as such. There is an indication of required research in related disciplines, but the details are not provided. Transportation is a system comprised of social and economic elements. The report has two parts. The first part explores the role of transportation in contemporary society and its relation to civil engineers' objectives. The second part highlights new research needs. A detailed study programme is offered, together with estimates of the financing needed to enhance the profession's ability to fulfil future transportation requirements. This is done to enhance the profession and satisfy future demands. Important subjects like soil mechanics and foundations, structures, and environmental concerns may appear to have been treated lightly. Transportation-related research in civil engineering is presented in this research paper.

Key Words: Transportation, Research, System, and Social Aspects

Introduction:

Transport is a hot issue. Some deplore the detrimental environmental effects of the rapidly increasing transportation infrastructure, while others stress the necessity for adequate transportation to service society[1]. According to one school of thinking, modern transportation systems show inadequate respect for human resources and environmental values[1]. This school of thinking also believes physical resources are pursued excessively[1]. “Opponents argue that public transportation systems must be economically sustainable and that society cannot afford needless investments. Before many transportation authorities, those who backed economically efficient systems recognised that those on the other side were deadly serious and knowledgeable and highly organised, the debate was already well underway"[2]. The highway initiative in metropolitan areas was an early target of the reaction, and it was one of the first objectives[2]. Several highway amenities were either turned down or, at the very least, put on hold. Following closely after were initiatives for air transport[2]. It was no longer commonly regarded that having airports near the major business districts of cities was the optimal placement. The constant roar of aeroplanes was the subject of several complaints[3].

Because of this, better jet planes were turned away from several airports. These unexpected assaults posed a significant threat to the tried-and-true methods of expanding transportation[2,3]. Suddenly, no one standard could be used as a foundation for the planning and positioning of transportation infrastructure[3]. The economic-return strategy was losing popularity, while the social-return approach became more popular[3]. The new base resulted in a poorer economic return, but it also drew attention to competing for social ideals that could not be precisely recognised or assessed. Even when such values were pretty precise, the society concerned with them did not assign precedence to them. For instance, society wanted higher safety and aesthetic standards, even though aesthetic treatments often result in lower safety standards. While complaints about air pollution were being voiced, proposals to enhance roadway conditions and cut down on pollution were being shot down[4]. These tensions between ideals occurred simultaneously as a rising need for cash to support a wide variety of expensive initiatives in the sectors of health, welfare, and culture[4]. This, of course, resulted in a larger level of rivalry for financial resources and a greater level of opposition to advances in transportation, most notably motorways, because of the pervasive influence they have on all aspects of society[4].

PRINCIPLES OF TRANSPORTATION

In today's world, even peaceful demonstrations may be heard[5]. As a direct result of these demonstrations, the economic rationale for transportation is no longer enough[4,5]. In addition, since technological advancement has made it possible to construct nearly anything, almost anywhere, it no longer has the power to prescribe a solution[5].

As a direct consequence of the circumstances above, there is no solid foundation to build a one-of-a-kind solution[6]. Practically any issue may be solved in an unlimited number of different ways. Because of this, there has been a never-ending cycle of arguments, disagreements, and compromises[6]. In the case of transportation, this has meant attempting to maintain service levels while being willing to make concessions when achieving certain goals[6]. Those who have worked in various forms of transportation have regarded travel either in terms of their own unique needs, as a reaction to users' wants, or as a chance to use newly developed technology improvements[7]. The need to make concessions has been acknowledged and the necessary modifications to acquire additional facilities have been carried out. However, there is no foundation upon which to base a discussion on how compromises should be reached.

In the same way that it is possible to give an excessive amount of transportation, it is also possible to supply an inadequate amount[7]. "A situation in which a highway infrastructure designed to accommodate 100,000 cars per day would need to be stretched by one-quarter of a mile to achieve a social or cultural advantage is an illustration of a dilemma that must be compromised" [7]. The added length results in an additional 25,000 vehicle miles of traffic every day, and it is estimated that one more death will occur every three years as a direct result of this additional travel[8]. This does not even begin to cover all of the advantages and disadvantages of this choice[8]. Therefore, what is required is a fresh look at the nature of transportation and its role in modern society. Both its positive and negative consequences need to be comprehended and evaluated in such a manner that allows for the possibility of making reasonable concessions[8].

A conflict resolution process based on comprehensive and factual views of the consequences of alternative actions is required for the best interests of society[9]. The act of transporting people or products from one location to another, whether for the goal of commerce or other reasons, is known as a transportation [9]. A transportation system is a collection of pieces (components or subsystems) that work together to facilitate the movement of people and products from one location to another [9]. The following is an alternative formulation for the second definition of the latter: A society's social and economic programmes (systems) are broken down into subsystems, and one of such subsystems is the transportation system. Because the movement must provide a "purpose," transport might be considered a service [10]. It is not the goal in and of itself; rather, it is a means to an end. The motive is merely for the sake of movement. However, the "end" may be connected to the motivation behind why the movement is sought [10]. It is not unusual to see the mode of transportation as more of a means than an aim in and of itself [10].

It is easy to think of several ways people may travel about for enjoyment, such as strolling, sailing, flying, driving, or riding a bicycle[11]. "Are these the appropriate nouns to use for transportation? Or, what about the activities that law enforcement and military personnel engage in while on patrol? Or transportation to a hospital that includes emergency medical care while the patient is transported there? Some of these actions serve a function throughout the movement process rather than only serving to complete the movement" [11]. However, one thing that is consistent across all of these scenarios is that transportation is never the final goal; rather, it is a service provided to either a person or an activity [11]. Most transport is performed as a service for a satisfying purpose after the conveyance is finished [12]. "The conclusion that may be drawn from this is that the service does not have any value of its own, that it is a waste of resources, and that the only reason it exists is because of what it makes possible" [12]. Therefore, transportation is a hindrance, and as such, it should be reduced to the greatest degree that is feasible. Again, the trip's aim will determine the level of success that can be accomplished by minimising the trip's impact [13]. This viewpoint is irrelevant because it is impossible to do away with the transportation service completely. The most important implication of this viewpoint is that it is impossible to comprehend the positive effects of transport on human resource development without first being aware of the ultimate goal that transport is meant to serve[13].

CIVIL ENGINEERING AND TRANSPORTATION

One of the most important aspects of this concept is the emphasis placed on the duty that engineers have for humanity[14]. One of the aims of the engineering profession is to come up with economically viable solutions, but this is not its only objective. "Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience, and practice is applied with judgement to develop ways to economically utilise the materials and forces of nature for the progressive well-being of mankind" [14]. The Engineers' Council for Professional Development proposed this definition of engineering[14]. Civil engineering has always placed a significant emphasis on ensuring the health and safety of the general people [15]. It is common knowledge that some of the first examples of engineering putting scientific advancements to use for the benefit of both people and society are documented in the annals of human history[15]. The value of engineering works, particularly in their ability to deliver "contentment" and happiness even to the people ruled by such works [15]. Alexander Gest's book, Engineering, has documentation of an attack on the United States by a foreign force [15]. According to Professor Gest, the following can be said about the expansion of the Roman Empire: "The Romans were a wise and knowledgeable people, even though the administration of their provincial governments was frequently unjust and oppressive. One of the distinguishing characteristics of the Romans was that they brought their civilisation with them to the countries they conquered. Sufficient to see that the longevity of their dominion depended on the loyalty and contentment of their subjects. As a result, once they had reduced a nation to subjection, they devoted their energies to the country's development and the promotion of the welfare of the people. In other words, they made sure that their subjects were happy"[16].

Over many centuries, some of the most technologically advanced societies have placed a significant amount of importance on the role of the engineer in order to achieve the highest possible level of comfort and convenience within the constraints imposed by society and the capabilities of available technology [17]. Space flight, nuclear energy, laser beams, and a host of other technological advancements that appear to defy belief are all hallmarks of the contemporary period, which may be contrasted with the times of the past in major ways [17]. However, in a different and fairly remarkable sense, this new period is more than distinct from the previous one [17]. There is no parallel to today's society's expansion and widespread wealth for fully using technology for comfort and ease [18]. Victorians were astounded by their time's technical achievements. Today's growth and prosperity are unmatched[18]. "We emerged from the industrial revolution, which was a continuance of the fundamental desire for survival, with just a few persons acquiring some luxury. In other words, the basic urge for survival continued" [19].

In the United States of America, most families spend a portion of their money on luxuries thirty to forty years ago would have been seen as "foolish" or "extravagant." However, in today's society, these purchases are commonplace [19]. Civil engineering has evolved throughout time in parallel with the changes that have taken place in the economy [19]. Since its basic purpose of identifying, planning, constructing and maintaining travel routes over which people and vehicles move, civil engineering has been more interested in expanding its scope to include a wider range of transportation-related activities. "Only a civil engineer's most apparent areas of interest include highways, railways, bridges, runways and taxiways, port improvements, pipelines, power production and transmission towers, tunnels, and drainage systems. The technical parts of this kind of engineering are supported by the specialist fields of engineering mechanics, soil and rock mechanics, hydraulics and hydrology, surveying and mapping, and photogrammetry" [20]. “Specialised areas are related to the unique nature of civil engineering and its need to construct facilities built primarily of local resources that may last 20 to 100 years" [20]. In addition, a considerable majority of civil engineering activities are government-run [20]. Due to the location and design's complexity, society and civil engineering have increased the requirement for planning, operation, and administration [21]. Because of the regulating nature of transport's most demanding technical sector, low-cost materials must be used to create engineering works with extended life [21].

Civil engineers are highly skilled in transport's most difficult technical area [22]. This technological domain is complex, especially for low-cost materials to create long-lasting engineering works. Civil engineers in the transportation industry are not indifferent to social problems while maximising economic efficiency and technical analysis [22]. "When determining route locations, we need to analyse all possible alternative alignments. This process entails locating all of the significant differences between the various alignments [22]. The degree to which each determinate is taken into account is highly dependent on the specifics of the planned highway construction, including its size, scope, location, and features of the surrounding region [22].

The range of numerical values that should be assigned to the different components is a topic that generates the most debate right now, and the most divergent opinions can be found in the field of social values [23]. However, we are now involved in substantial research that aims to quantify these qualities. Thus, the civil engineer's technical interest in transportation seems to be stable [23]. This does not mean his technical background, knowledge, or practices will not change; it only means his specialised core area will not [23]. The analytical level of giving alternative solutions for issues about public welfare will be the primary focus of the civil engineer's attention shift in the transportation sector. Because of this shift in interest, he must possess the skills and knowledge necessary to collaborate with individuals from other fields to establish the objectives and standards upon which future advancements in transportation will be based [24].

Two separate contributions from the civil engineer will be necessary to develop the goals and criteria. The first has to do with the ever-present demand for individuals with the technical expertise to design, build, and run systems [24]. The second concern is the multi-disciplinary research that must be done before setting transport objectives [25]. The management of public works will be entrusted to government officials who take an objective perspective on the well-being of the general population. "Transportation decision-making will require a variety of technological backgrounds, including the analytical and technical expertise of civil engineers and other professionals" [25]. Planning for the desired change is important because its results, or lack thereof, determine the other problem areas' options. The lack of proper planning for expanding the air transportation system is a primary contributor to many of the current issues in this industry [25]. Civil engineers are responsible for more system planning. There are societal, economic, and political issues beyond his professional responsibilities [26]. Although this is true, civil engineers' proven system analysis and design skills are critical to developing system development plans [26]. Planning for desired change requires more system engineering and planning research [26].

Students of Civil Engineering Participating in PBL and B-Learning Activities in the Transportation Course

Problem-based learning, project-based learning (also known as PBL), and blended learning are components of this instructional method (B-learning). Each year, a new challenge was presented to the community. On the other hand, problem-based learning was developed further into project-based learning [27]. “The students performance was evaluated using the following components: grades in course activities and cognitive maps made to evaluate the effects of PBL by comparing the responses provided by students who participated in the experiment with those of students who did not participate in the experiment” [27]. The findings revealed favourable characteristics of the approach, such as a significant level of participation on the part of some pupils with the topic [28]. It is not easy to accomplish the instant incorporation of emerging methods and the development of new skills desired by the industry in most civil engineering schools in India due to the inflexible curriculum used in these institutions. Some of the courses offered by the Civil Engineering Department of the Transportation Engineering group of the IITs are undergoing revisions to better cater to the market requirements [28]. These alterations are being made to foster the development of professionals who have a robust capacity for adapting to the shifting trends and requirements of the market. This is done while retaining the educational standards based on sound theoretical foundations and excellent practice in engineering, which has been a tradition at IITs for more than 50 years [28]. This is done while retaining the educational standards based on sound theoretical foundations and acceptable practices in engineering.

The above may be accomplished by focusing on enhancing the teaching and learning process [29]. This may be accomplished via forward-thinking educational techniques complemented by information and communication technology (ICT). This article will discuss one of the pedagogical alternatives used in the class "Transport Systems Planning and Analysis," which will be applied in the course [29]. "Students of civil engineering who are currently enrolled in the sixth semester are the target audience for the class at IIT (out of ten). Problem-based learning (PBL) and a learning management system are linked together in the strategy that has been suggested (LMS)" [29]. The course covers ideas about the economic and social elements of transportation systems and the effect those factors have on the design and operation of transportation [30].

IITs were originally presented in the class for the first time in 2006 with a problem that most students were already aware of: the lack of parking in the region around the university campus. "The following year, the primary emphasis was placed on the significant transportation issues plaguing the medium-sized Indian city in which IITs are situated [31]. In that specific instance, the students relied on the findings of a field survey that the Department of Transportation of IITs had recently completed" [31]. In 2008, the students discussed the mobility difficulties that pedestrians experience [31]. They were required to consider the degree to which urban areas are accessible and the calibre of the pedestrian infrastructures already in place inside the city. Because of this, the strategy from 2006 to 2008 focused almost entirely on identifying the issues, and it was only superficially concerned with the development of potential remedies [31]. In 2009, project-based learning was included, and the final course project became a complete product that answered transportation problems. In this scenario, students were tasked with rethinking metropolitan public transit [32]. They were provided data from an origin-destination study by IITS' Department of Transportation. "This enabled them to accomplish their goal.

Collaboration was a key component of the strategy throughout all four years, which also made extensive use of a learning management system (LMS) called Courses On-Line (CoL)" [32].

Problem-Based Learning

The primary distinction between the so-called "traditional" method of teaching and problem-based learning, or PBL. "The latter seeks to ensure that students understand the facts instead of simply memorising concepts, descriptions, or formulas" [33]. Students are required to develop skills in cooperative work and interpersonal relationship building due to the method's heavy emphasis on teamwork. These are unquestionably advantageous qualities for the emerging professionals being trained [33]. This technique also benefits the teachers since they often pick up new information as the class progresses, even though the process is difficult and presents ongoing challenges [33].

Even problem-based learning (PBL) has its detractors and flaws. In addition, even while project-based learning may be beneficial to engineering education in general, the necessary adjustments are often required [34]. In transportation engineering, a fast online search should also find multiple institutions that employ problem-based learning. They may be found in nations as far apart as Malaysia, the United States, Spain, or Ireland, among other possible locations [35]. On the other hand, it might be difficult to track down reports in India that detail situations comparable to yours. The present educational push in transportation engineering is crucial and relevant for the nation and other places where the notion has yet to be created. Even in nations where the approach is used in transportation instruction, reports of the experiences are uncommon, with notable outliers [35].

Blended-Learning

Computers have most often been used in the roles of instruments for the processing and conveying of information and aspects of decision support[35]. They took on a new dimension when they started to be utilised extensively for education, training, and personal development. Some education researchers who were deeply interested in finding ways to make the teaching and learning process more effective concluded that neither online platforms nor purely theoretical approaches to the teaching and learning process could produce an environment conducive to effective learning [35]. Despite the promise of these new technology instruments, this was the situation. This limitation may be avoided by using the blended learning strategy [35], which combines information technology resources with the more traditional teaching method (b-learning). The teaching and learning process in conventional face-to-face classrooms is merged with remote education's online experiences. This process is referred to as "b-learning." In that setting, it would be possible to establish a class based on research [36]. In essence, it is the teacher's job to excite the students while also demonstrating to them the value of the material that is to be studied and the significance of the method to be followed. Apprentices' growth is directly correlated to their level of motivation and participation in the training programme [36].

After a verbal or multimedia presentation to stimulate the students' attention, they are free to search alone or in groups for further information on the topic [36]. The Internet, books, genuine experiences, and experts in the industry might all be excellent sources of knowledge on the issue. Then, the most valuable information selected by students and teachers is gathered and made accessible to the class [36]. After that, the findings are brought back to the classroom, where the teacher and the remaining students collaborate to decide the context in which the results belong. This leads to expanding viewpoints, identifying issues, and developing new meanings within the obtained material. Everyone is urged to engage in the collaborative process, which is exciting, creative, full of discovery and development, and eventually culminates in a greater understanding of one's own experiences [37]. The technology now available for use in distance education is a significant component in deciding the success of a given b-learning endeavour [37]. The dynamic tools that are learning management systems offer for encouraging instructor-student engagement in discussion forums, electronic communication (such as e-mail and chats), and collaborative activities add to the system's overall efficacy. Consequently, both b-learning and remote learning may profit from using these technologies [37].

Civil engineers are directly involved in almost every facet of highway traffic. The only areas in which they are not engaged are perhaps vehicle design and manufacturing and highway operations regulation [38]. Major technical concerns (surveying route sites, designing pavements and bridges, and the controlling demand for a highway over which to function) led to the civil engineer's engagement in various tasks, including planning, funding, traffic control, and safety [38]. Consistent increases in the number of cars and trucks and population expansion have led to an increase in the number of drivers and the number of vehicle miles travelled, which in turn has increased the need for more highway amenities [38]. As a direct result, the technical problems encountered by civil engineers switched suddenly from the typical rural site and pavement and bridge design to the comprehensive concerns faced by metropolitan regions and traffic flow and safety issues that include human behaviours [38]. As a direct result, almost every scientific field is now included in highway transportation. There was a tendency to split the duty among several components, such as highway drivers and cars, which impeded the development of a unified system[38].

Conclusion:

Transportation is at the centre of a heated discussion. One side thinks that the transit systems, which are being supplied, show too little care for human resources. The opposite side thinks that transport systems must be economically efficient and that society cannot afford expenditures that may be non-productive from a transport service point of view. There are multiple answers for nearly every issue, but no clear foundation exists for producing a unique solution. Just as it is possible to offer too much transportation, it is conceivable to provide too little. The best interests of society demand a method of resolving disputes that are founded on complete and factual views of the effects of different choices, not limited and emotive viewpoints of what is "good or evil". A transportation system is a combination of factors that aid in the deliberate movement of people and products from one location to another. Consideration of travel as a means rather than a destination is not uncommon. The advantages of transport to human resource development cannot be appreciated unless via understanding the transport's ultimate goal. Traditionally, concern for public welfare has been an essential aspect of civil engineering. The efficacy of engineering works in bringing about "contentment" and happiness even to people controlled by a foreign authority is documented by Alexander Gest in his book, Engineering. Civil engineering's interest in transportation has widened substantially. Civil engineering additionally may be classified by the comparatively large proportion of its operations that governments supply in the public interest. While immersed in economic efficiency and technical and analytical heritage, civil engineers in transportation have not been indifferent to social considerations. However, the civil engineer is still responsible for delivering and maintaining the facility, and as a consequence, this is in critical need of contributions from other disciplines of study. The under-optimisation of roadways is another problem that has to be addressed.

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