Exploring the Relationship between Building Construction Activity and Road-Related Expenditure in Victoria

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Abstract—Road-related expenditure and building construction activity are two significant drivers of the Victorian economy. This paper investigates the relationship between building construction activity and road-related expenditure. Data for construction activities were collected from Victorian Building Authority, and road-related expenditure data were explored by the Bureau of Infrastructure and Transport Research Economics. The trend between these two sectors was compared. The analysis found a strong relationship between road-related expenditure and the volume of construction activity, i.e., the more construction activities, the greater the requirement of road-related expenditure, or vice-versa. The road-related expenditure has a two-year lag period, suggesting that the road sector requires two years to respond to the growth in the building sector.

Keywords—Building construction activity, infrastructure, road expenditure, Victorian building authority.

I. INTRODUCTION

VICTORIA, a state of Australia, has several competitive advantages that create a diverse, flexible and resilient economy. These include: world-class industries; a skilled workforce; a multicultural population; proximity and links to the fast-growing Asian region; world-recognized liveability and reputation as a tourist destination; good transport networks with well-connected cities and regions; and access to productive agricultural land and energy resources [1]. The Victorian Government has identified the construction materials and technologies industries as one of several sectors strategically important for the State. This sector has the potential for strong growth and jobs. The construction industry is a major sector in the Victorian economy contributing around 7% of the State's gross value. Construction is undertaken within a complex system that coordinates the activities of many actors to design, build and complete projects within regulatory and institutional frameworks. Victoria's construction sector can be considered as the market for Victorian construction materials and construction technologies. The construction sector accounts for about 8% the workforce, placing it as Victoria's fifth largest industry sector [1] though the medium-term outlook for building and construction activity in Victoria is mixed [2]. The construction sector comprises residential building, non-residential building and engineering construction. Residential construction includes new houses, units and apartments and alterations and additions. Non-residential building includes offices, accommodation, education, entertainment, health and age care, industry and wholesale and retail trade. Engineering construction includes roads, railways, bridges, harbors, water, sewerage, electricity, pipelines, telecommunications and mining.

The Victorian state government is delivering a wide range of road-related projects to boost the Victorian economy [3], [4]. A number of studies are related to road-related expenditures [5]-[8]. However, previous studies related to road-related expenditures have not identified the relationship between the road-related expenditures and the building construction activities. The paper aims to identify this relationship. In this paper, it is hypothesized that the increase of the number of building permits for construction of houses in new and established areas will put pressure on transport network and subsequently, the road-related expenditures from different tiers of government need to increase to cope with the increasing demand.

The primary objective of this paper is to understand the relationship between building construction activities and road-related expenditures. This paper summarizes a research project focused on Victoria, Australia.

The paper is structured as follows: The next section presents the methodology used in this research. That is followed by a description of the trends of building construction activities and road-related expenditures. A regression analysis between the cost of construction activities and road-related expenditures is then presented. The paper concludes with a summary and an outline of areas for future research.

II. METHODOLOGY

Building construction activity data were collected from the Victorian Building Authority (VBA). The VBA collects building permit activity data in accordance with its legislative requirements as per the Building Act 1993 and the Building Regulations 2018. After the issuance of building permits, building surveyors submit the permit related information to the VBA. The VBA summarizes the information provided by the building surveyors in terms of number of building permit issues and the estimated cost of construction for these building activities. The summary categorizes total building construction

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activities into several building use classes such as domestic, residential, commercial, retail, industrial, hospital/healthcare and public building buildings.

Road-related expenditure data were collected from the Bureau of Infrastructure and Transport Research Economics (BITRE). The BITRE or other Australian state or territory government agencies collect statistics related to infrastructure and the economy, transport, communications, water and energy and the BITRE publishes the Australian Infrastructure Statistics Yearbook. The Yearbook provides an updated annual source of infrastructure statistics. These statistics can be used by the wider community to understand long-term trends in a wide range of Australian infrastructures.

A regression analysis was performed to estimate the effect of building construction activities on road-related expenditure. Before performing the regression analysis, the time series data for both construction and road were smoothened by using a three-year moving average method. This averaging eliminated the noise of random outliers and created a series representing long-term trends.

III. TRENDS IN BUILDING CONSTRUCTION ACTIVITIES AND ROAD-RELATED EXPENDITURE

Fig. 1 shows the total estimated yearly cost of building construction over the last decade (2011-2019). These data include the new construction, extension to the already existing property and internal refurbishments. The VBA collects building permit information from building surveyors each month. These data are then summarized as Building Permit Activity Data for the period specified.
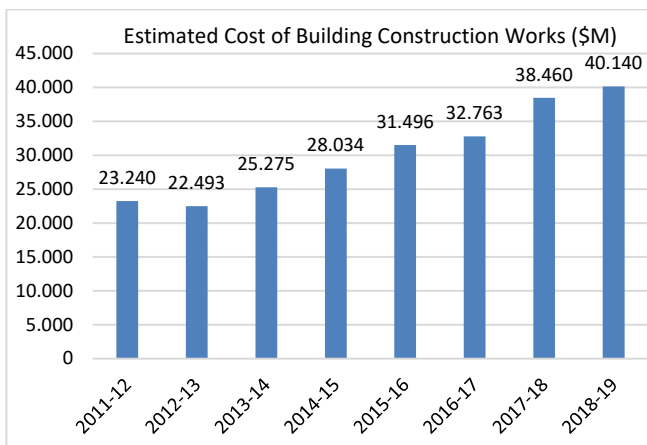

Fig. 1 Cost of building construction [9]

The estimated value of building construction works has increased about 10% per annum and the value has almost doubled over the decade (2011-18). However, the increase is not smooth over the years. The data have been smoothened using three-year moving average method. The smoothened value of construction works is shown in Table I.

Fig. 2 shows the expenditures on roads by all government levels in Victoria – the local, state and commonwealth governments. The road-related investment has almost doubled

over the decade 2011-2018.

TABLE I
THREE YEAR MOVING AVERAGE OF ESTIMATED COST OF CONSTRUCTION ACTIVITIES (BASED ON [9])

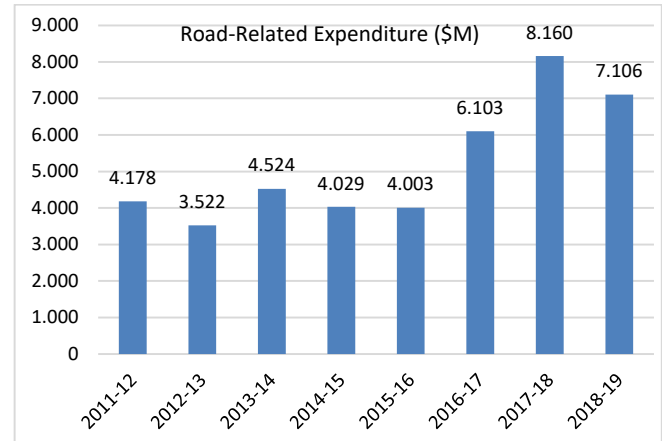| Year	Estimated Cost of Construction ($M)
2012-13	23,669
2013-14	25,267
2014-15	28,268
2015-16	30,764
2016-17	34,240
2017-18	37,121

Fig. 2 Road-related expenditure [10]

The estimated value of road-related expenditure has increased about 10% per annum. However, the increase in this expenditure is not smooth over the years. The data have been smoothened using three-year moving average method. The smoothened value of road-related expenditure is shown in Table II.

TABLE II
THREE-YEAR MOVING AVERAGE OF ROAD-RELATED EXPENDITURE (BASED ON [10])

Year	Road-Related Expenditure ($M)
2012-13	4 075
2013-14	4 025
2014-15	4 185
2015-16	4 711
2016-17	6 089
2017-18	7 123

IV. RELATIONSHIP BETWEEN CONSTRUCTION ACTIVITIES AND ROAD-RELATED EXPENDITURE

Fig. 3 shows the relationship between road-related expenditures and the estimated cost of construction from 2012 to 2018. The two variables are strongly correlated ($R^2 = 0.89$).

Fig. 4 shows the relationship between road-related expenditures and the one-year lag building construction costs from 2012 to 2018. One-year lag building construction costs indicate the construction expenses occurred one year before the road-related expenditures. The two variables are very strongly correlated ($R^2 = 0.95$) and the good-of-fit has improved in

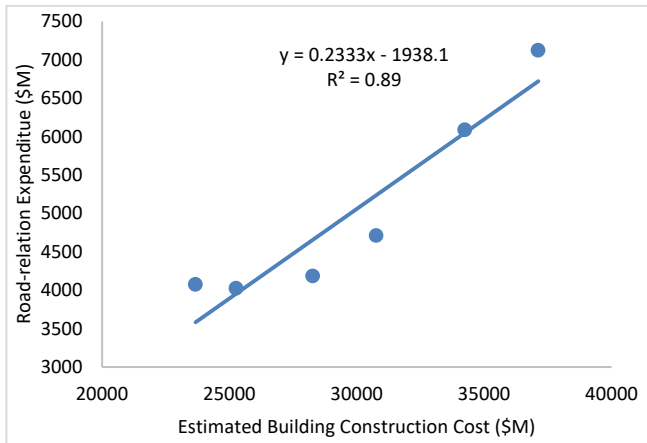World Academy of Science, Engineering and Technology
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comparison to Fig. 3.

$$y = 0.2333x - 1938.1$$
$$R^2 = 0.89$$

Fig. 3 Road-related expenditure vs. estimated cost of building construction

$$y = 0.4218x - 5858.9$$
$$R^2 = 0.99$$
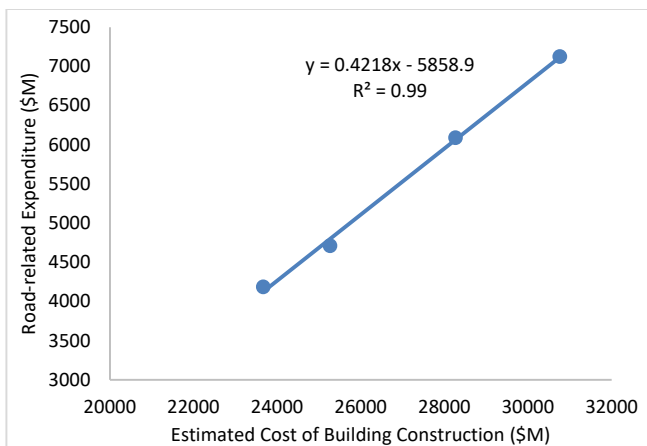
Fig. 4 Road-related expenditure vs. one-year lag building construction costs

$$y = 0.3078x - 3526.2$$
$$R^2 = 0.95$$

Fig. 5 Road-related expenditure vs. two-year lag building construction costs

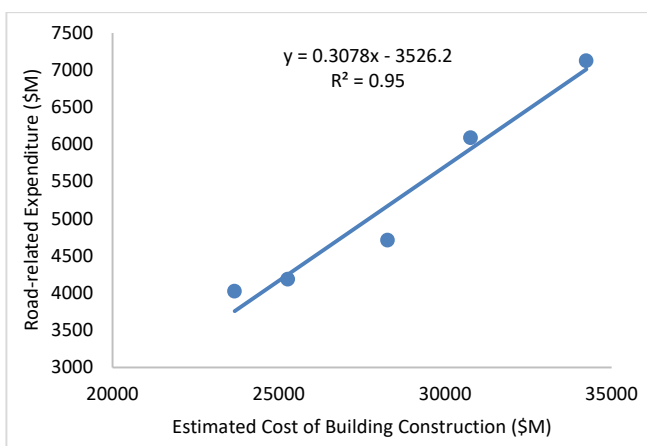Fig. 5 shows the relationship between road-related expenditures and the two-year lag building construction costs from 2012 to 2018. Two-year lag building construction costs indicate the construction costs occurred two years before the road-related expenditures. The two variables are very strongly correlated ($R^2 = 0.99$) and the good-of-fit are better than both Figs. 3 and 4. This regression analysis suggests that transport sector follows building the construction industry. There seems to be about a lag of two years between building construction and the commencement of road-related expenses.

A wide variety of infrastructures including utility connections, roads and public transport, schools, hospitals, community infrastructure and telecommunications are required for the residents of a newly developed area to provide access to employment, services and amenities [11]. A considerable amount of new investment [12] is needed from the different levels of government and they are responsible for funding most of this infrastructure, in full or in partnership with others. Victorian state and local governments expected to spend tens of billions of dollars over the next decade to develop greenfield infrastructure and transport infrastructure provision as a single greatest expenditure element is likely to account for over half of this amount [13]-[15]. The exact quantum of expenditure in the newly developed areas will depend on how quickly the settlement occurs in these areas.

The lag time between housing provision and infrastructure provision is also evidenced by Henderson [16] who noted that there is a pressing demand for infrastructures in new and developing communities but in some cases some of these infrastructures are arriving long after they are required. Outer suburbs in Melbourne and certain new growth corridors in Victoria offer housing opportunities as they provide the most affordable homes to purchase, however, they do not necessarily provide affordable living because these new developed areas have less accessibility and less associated opportunities in comparison to the other established areas of Melbourne. These residents are supposed to face difficulty to access services due to lack of relevant infrastructure.

A robust integrated approach should be used to meet the infrastructure needs of the newly developed growth areas, however, the planning process of infrastructure development for new suburbs on the urban fringe of Melbourne is not straightforward as a significant amount of complexity is associated with this process due to the involvement of a wide variety of stakeholders. A collaboration among the stakeholders such as the Victorian state government, local governments, landowners, private developers, utility companies, service providers and other relevant interest groups is required to promptly deliver the infrastructure needed for the growing communities [17]-[19]. Though the Victorian Planning Authority on behalf of Victorian state government coordinates the development of precinct structure plans [20] for new growth areas to accommodate increasing population [21], no single entity is responsible for providing leadership for the delivery of infrastructure and services and thereby no one entity can be held accountable for the failure of delivering infrastructure in a timely manner. Therefore, future infrastructure arrangements should provide greater clarity on stakeholder responsibilities and facilitate better collaboration to drive productivity.

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V. Conclusions

The key findings of the current analysis are as follows:

➢ Both road-related expenditures and construction activities have increased significantly over the decade. The construction activities and road-related expenditures are interrelated.

➢ The result of the basic regression analysis between the road-related expenditures and the construction activities of the same year shows that they are positively correlated.

➢ The regression analysis between road-related expenditures and the one-year lag building construction costs indicates an R^2 value of 95%.

➢ An R^2 value of 99% results from the regression analysis of between road-related expenditures and the two-year lag building construction activities.

➢ Transport sector follows the trend in construction activities and there is a lag of about two years in transport industry.

The findings of this research should be interpreted cautiously as the analysis is based on a particular state in Australia. In addition, the analysis is based on limited data. Further research is warranted to establish a robust relationship between road-related expenditures and building construction activities.

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