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Structural Model on Construction Maintenance Cost of State Building

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ABSTRACT

The growth of buildings construction in Indonesian experiences improvement to support daily activity optimally. The various forms, sizes, and aesthetics of building represent the people's activity that occupied it. Constructing of buildings construction also has to consider how to maintenance the buildings as the buildings are used. Indeed, need to calculate the maintenance and treatment costs accurately in order to age of the hoped construction can be achieved. The office buildings are the one of property product. State ownership office buildings are categorized become 3 (three) part, i.e., *rent office, office, government office*. As for, this research object is state ownership office building of all this parts. This research is done by taking 250 (two hundred fifty) samples with *purposive sampling method*, respondent in 80 (eighty) public ownership office buildings at north Sumatera Province. Data collection by questioner that have 6 variables, 18 dimensions, and 54 indicators. Results of data collection are processed by AMOS version 21.0. At *Structural Equation Modeling (SEM)* based on covariance. From the results of data processing are obtained that maintenance and treatment management of state building constructions have greatly big direct influence toward the level of this constructions damage. In addition, have the biggest indirect influence toward construction maintenance cost at Anggaran Pendapatan dan Belanja Daerah (APBD)
KEYWORDS: public ownership office building, variable, dimensions, indicator, SEM

INTRODUCTION

The requirement for building construction to various activities more and more increase from time to time. This is as one indicator that economic circle rotate in line with the increasing of various human activities in to perform transactions. This research is focused at public ownership of state building to various requirements.
The purpose of the establishing a building as referred to is to support activities or as facilities for building owner or building user to form his or her daily activities optimally.

Building with its style represent characteristic of allocation of the building, for example, the building, which will be functioned to banking activities, will be differed with the building designed to office complex. [1][2][3]. Building construction will experience degradation at age strength each year. Of course, need to be maintained and treated well in order to age of building can be held so that the building constantly can fulfill the building's function and reliability according to the terms that have been settled, [4].
Each buildings constructions has to be maintained and treated well according to message of constitutions of building maintenance benefit, [5][6][7].

1. Fulfill the requirement as well as hoped according to production plan and plan age of building.
2. Maintain the material quality or construction component at a construction and prevent the spreading of material quality also return it at the origin condition.
3. Help to reducing the consumption and storage out of limit; also keep the capital for the fixed time according to the policies.
4. Using the cost as low as possible to form the building maintenance activity effectively and efficiently.

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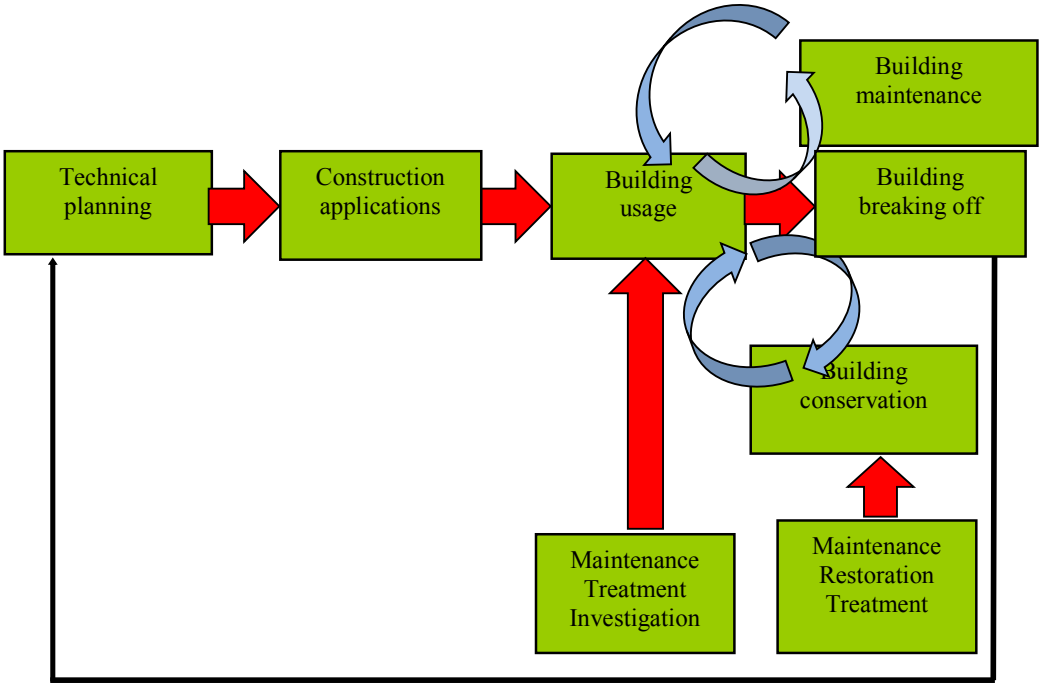


Source: result of research engineering

Figure 1. Process of building implementation

From Figure 1. Process of building implementation, seen that building maintenance is the working after the building finished to be build. Building maintenance as one aspect that becomes input to building usage and building conservation, so that the building can be used by maximal, [1][4].

Maintenance of building construction includes the terms connected with, [8][9][10]:

1. Safety of the building construction.
   Safety of the building construction is conditions that guarantee the safety and prohibited of disaster, among of them are fire, earthquake, thunderbolt, high wind, and flood, in a building along with residence expense that includes human, equipment, and goods, caused by failure or un-functioned of building utility.
2. Security of building constructions
   Security of building construction is a condition that guarantees the preventing of all interruption either by humans, climates, or other crimes toward building.
3. Health of building construction
   Health of building construction is a performance that becoming health situation on ill, pollution, and contamination threat through building vaporization, illumination, hygiene, and sanitation.
4. Comfortable of building constructions
   Comfortable of building constructions are a condition that provide various easiness needed according to rooms or buildings function and/or environment so that occupant able to done his activity well, like, and productive.
   Scope of comfortable covered, [11] [12]
   a. Motion room that include room size, capacity, in lay-out, furniture, and circulation arrangement (horizontal and vertical). The maintenance methods are by user observation and survey.
   b. Air conditions that include thermal condition and equipment condition. The maintenance methods are by user inspection, measurement, and survey.
   c. View and *privacy* that includes the opening system, in lay-out, and exterior. The maintenance methods are visual observation, user survey, and study.
   d. Noise and vibration that includes the source installation also damper and acoustic component. The maintenance methods are by observation and measurement.

5. The easiness of building construction
   The easiness of building construction is a performance that becoming the condition is completely easy in using of building through room - *Lay-out* and the completeness of infrastructures.
   Scope of easiness covered:

   a. Room *lay-out* that includes the circulation pattern, disable accessibility, evacuation path, also in lay-out and furniture. The maintenance methods are by observation and study.
   b. Building equipment that includes the small room, toilet, locker, *pantry*, religious service room, parker, *dropping area*, and ash can. The maintenance method is by inspections.
6. Reliability of building construction.
   Reliability of building construction is the guaranteed of perfection level of protection tool condition that guarantee the safety, function, and the comfortable a building construction and its environments during building usage time and from the risk aspect toward fire.

In the book of *Modern Maintenance Management*, the specialist divided the maintenance activity in 5 (five) category, [10] [12] that are:

1. Regular maintenance
   It is applied continually in order to the certain time interval that has been planned depended on material quality of the used component. It is usually done by daily.
2. Periodic maintenance
   It is as the planned maintenance for the component, which is yet used. This maintenance is done to component that has maintenance technique and special skill, like cleaning, and replacement of AC channel, inspection at the security system toward fire and others.
3. Long term maintenance
   This maintenance is done to lengthen the economical age of a component by doing replacement of element of that component.
4. Building structure maintenance
   This maintenance is done to retain a construction from building structure in order to isn't happened damage
5. Emergency maintenance
   This maintenance is done if there is occurred damage at component, which is not interpreted before. It is done to anticipate the work system of component.

As for the kind of maintenance activity consist of, [9] [11]:

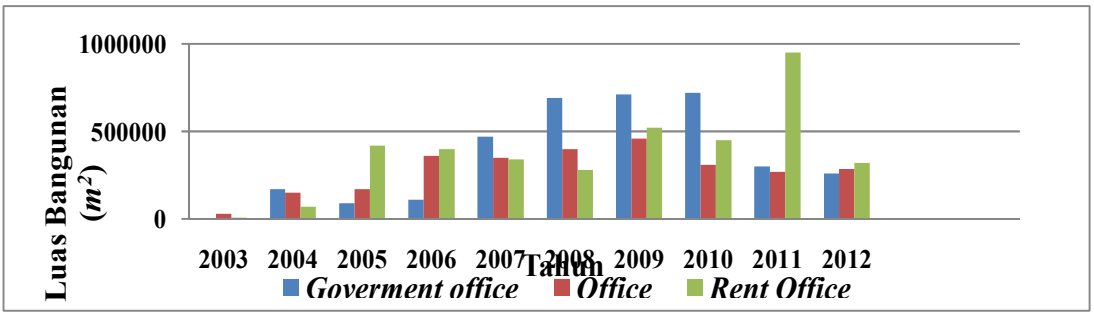
1. Planned
   a. *Preventive Maintenance*
      Preventive Maintenance is a maintenance activity done to prohibit the increasing of the un-supposed damage and find the situation or the un-supposed situation also finds a situation or condition, which can cause the production facility experience damage as is used.
      Preventive Maintenance can be done by making *schedule plan maintenanc*e, investigation or inspection and replacement, spare-part procurement that can be estimated the age after long life.
      Preventive Maintenance benefit is economize the energy, avoid the all need damage, improving the tool efficiency, lengthen the tool age, keep the quality or performance of the building, keep the continuity of operational, taking care the assets, the tool can be operated effectively and efficiently.
   b. *Predictive Maintenance*
      Predictive Maintenance is the repairing action based on information from the result of field inspection. This action as activity, which is done which the sources are founded indirectly.
   c. *Corrective Maintenance*
      Corrective Maintenance is maintenance activity after rise or time is raising damage. This activity often called repairing action and need to consider the cost that rise.
2. Unplanned
   Breakdown Maintenance is a maintenance activity, which is occurred accidentally which is occurred out of prediction or the schedule of damage cause or un-functioned a system or tools. This case is greatly avoided in order to be not happened. The emerge impact caused by this unplanned is greatly big and lose all side.

The maintenance activities are also divided on, [13] [14] [15]:

1. Servicing
   Servicing representing success service done regularly with certain time interval. It is usually called daily maintenance.
2. Rectification
   Rectification is activity frequently happened at the early building age caused by false on inappropriate of component, breakdown at installation time and false at assemblies.
3. Replacement
   Replacement is an activity unable to be avoided, because material service condition declined.
   Building maintenance is not addressed to improving the systems or tools ability or capacity above its maximum ability. However, building maintenance to prevent the building of all damage.

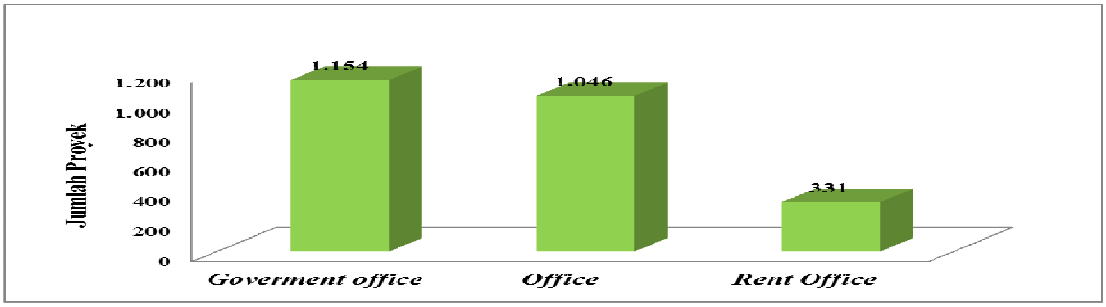
As for official building construction can be categorized, become 3 (three) part, that are, [16] [17]:

1. *Rent Office*
   Office that is rented by developer and office built by developer to sold
2. *Office*
   Private office owned and is self used by the owner
3. *Government Office*
   Public ownership office (Department, official, BUMN, BUMD, and others)



Source: result of research engineering

Figure 2. The large of wide of office building construction



Source: result of research engineering

Figure 3. Amount of office project

From the Picture 2. The large of wide of office building construction, and the Picture 3. Amount of office project was survey outcome done by *Citra Data Team* from years 2003 – 2012, in the picture was shown that *government office* was more built compared with other kind office building construction and the wide of *government office* began to reduce, [18] [19].

Was shown that government began to tight the maintenance and treatment job of public building construction if observe of the wide of state building construction that was built, [20] [21].

According to Law of Ministry of Public Work No. 45/PRT/2007 date December 27, 2007, about technical manual of development of public building construction [22], was mentioned that state building constructions are buildings construction to official requirement that become/will become property owned by state, and is existed by financial source that originated from APBN fund, and/or other legal income, for example; office building, school building, hospital building, building, state home, etc.

Public building construction need attention seriously in its maintenance, because as building to society service. The prima society service has to be supported by the treated and maintained construction well.

Public building construction is the one of state/local ownership goods purchased or acquired on expenses of APBN / APBD. As one state/local asset, then have to be used according to the function and have to be maintained as good as possible. It was contained in Law of Government Republic of Indonesia No. 27 year 2014, about Management of State/local ownership goods, [23].

Law of Ministry of Public Work No. 24/PRT/2008 Date 30 December 2008, about maintenance and treatment manual of building construction, [24] [25].

According to Law of Ministry of Public Work No 24/PRT/2008 Date 30 December 2008, about maintenance and treatment manual of building construction [24], the extent of building construction maintenance:

1. architectural
   The maintenance job is:
   a. Maintain well and regularly the escape as rescuer facility (*egress*) for building owner and user.
   b. Maintain well and regularly the escape as rescuer facility (*egress*) for building owner and user.

   c. Maintain well and regularly the elements in the rooms also the equipment.
   d. Supply the adequate and well-functioned maintenance system and facility, in the form equipment or fixed tools and/or working auxiliary tools (*tool*).
   e. Do maintaining the right decoration and architectural ornament by official with expert and/or competence in his field.
2. Structural
   a. Maintain well and regularly the elements of building construction structure from corrosion, climate, humidity, and loading out of limit of capability of the structure, also other contamination.
   b. Maintain well and regularly the elements of structure protector.
   c. Do inspection periodically as part of preventive maintenance
   d. Prohibit the change and/or addition on activity function that cause the improvement of load that work at building construction out of limit the planned load.
   e. Do maintaining and repairing the right structure by official with expert and/or competence in his field.
   f. Maintain the building in order to be functioned according to usage that has been planned.
3. Mechanical (Aerologic, Sanitation, Plumbing, And Transportation In The Building)
   a. Maintain and conduct inspection periodically the aerologic system in order to quality of air in the room is constantly fulfil the technical and health terms that is signed, includes the main equipment choosing and air channels.
   b. Maintain and conduct inspection periodically at water distribution system that includes the providing the clean water, worst water installation system, hydrant system, *sprinkler* (water sprayer), septic tank, and waste processing unit.
   c. Maintain and conduct inspection periodically the transportation system in building, either as lift, escalator, travelator, stairs, and other vertical transportation tools.
4. Electrical (Electric, Lighting, Telephone, Communication, and Alarm)
   a. Do inspection periodically and maintain the equipment of the reserve electrical generator
   b. Do inspection periodically and maintain the lightning-conductor equipment.
   c. Do inspection periodically and maintain the electrical installation system, either to electric power supply or to room lighting.
   d. Do inspection periodically and maintain the sound system and communication (telephone) installation net also data.
   e. Do inspections periodically also maintain the danger sign and alarm system networking.
5. Out layout
   a. Maintain well and regularly the situation also the land surface and/or external yard of building construction.
   b. Maintain well and regularly the gardens elements out and in of building construction, like vegetation (*landscape*), hardship field (*hardscape*), out space equipment (*landscape furniture*), drainage canal, fence and gateway, out lighting lamp, also post or guardhouse.
   c. Keep the cleanness out of building construction, yard, and its environment.
   d. Do maintaining the yard correctly by official with expert and/or competence in his field.
6. *Housekeeping* (Tata graha)

The activity scope is *cleaning service*, *landscape*, *pest control*, and *general cleaning* program began of work preparation, operational process, until the result of final work.

Maintenance and treatment of public building construction is constrained by the limited local government budgeting cost. In addition, as a challenge how in order to plan the maintenance and treatment cost of state building construction effectively and efficiently.

Moreover, there are also limitations on staff amount to inspect each state building construction. Also routine maintenance often become problem in the case of the working, whether is done alone by the appointed staff by the top or is done by a special institution that handled the routine maintenance.

Likewise, if building breakdown is occurred, the building repairing can be done by the existed staff in the office or by an experience institution/contractor to handle the repairing of building construction.

All need to be calculated in order to be found the maintenance and treatment cost of state building construction effectively and efficiently.

As regards to the damage of state building construction is interpreted as its un-functioned the building or constructions component caused by depreciation or its end the building ages or caused by human act or nature behaviour like the excess function load, fire, earthquake, or other cause a like.

According to Law of Ministry of Public Work No. 45/45/2007 Date 27 December 2007 about technical manual of the building of state building construction [22], is called that the intensity of the damage of building can be categorized on 3 (three) damage level, that is:

1. Light damage

   Light damage is damage mainly on non-structural component, like roof cover, canopy, and floor cover and filler wall.

2. Medium damage
   Medium damage is damage in part of non-structural component and or structural component like roof, floor, and others.
3. Heavy damage
   Heavy damage is damage in a great deal of building component, either structural or non-structural that if have been repaired still can be functioned with well as well as should be.

While, according to Law of Ministry of Public Work No. 24/PRT/2008 Date 30 December 2008 about maintenance and treatment manual of building construction, [24]. The intensity of damage of building is categorized on 3 (three) damage levels, that is:

1. Light damage
   a. Light damage is damage mainly on non-structural component.
   b. Like roof cover, canopy, floor cover, and filler wall.
   c. Treatment to light damage level, the maximum cost is 35% of the highest unit price of the building of the new building construction behaved, for the equal type/class and location.
2. Medium damage
   a. Medium damage is a damage at a part of non-structural component, and or structural component like roof, floor, and others structure.
   b. Treatment to medium damage level, the maximum cost is 45% of the highest unit price of the building of the new building construction behaved, for the equal type/class and location.
3. Heavy damage
   a. Heavy damage is damage at a great deal of construction component, either structural or non-structural that if have been repaired still can be functioned with well as well as should be.
   b. The maximum cost is 65% of the highest price unit of the building of the new building construction behaved, for equal type/class and location.

MATERIALS AND METHODS

1. Research Methods/Strategies
   This research method or strategy by descriptive method, i.e., searching the fact by the exact interpretation. This method is done by establishing surveys to research subject and object.
2. Research Data Type And Data Collection Method
   This research data is quantitative data by Likert (1 – 5) scale. Data sources are founded from primary data and secondary data.
   Data collection method with spreading the questioner to find the answer results from respondent. [26] [27] [28]
3. Respondent
   Research respondent is a person who knows and has responsible toward research object. This research object is public building construction in North Sumatera Province area. At this research the respondent coming from:
   a. Goods/service user, that is, the staff that existed in state building construction and also the staff who is ever involved in the repairing project of state building construction.
   b. Goods/service provider, that is, contractor or consultant who worked the maintenance of state building construction, either routine maintenance or repairing maintenance.
   c. The society in around the public building construction who frequently come to the state building construction to ask a prima service from the local government represented by academician

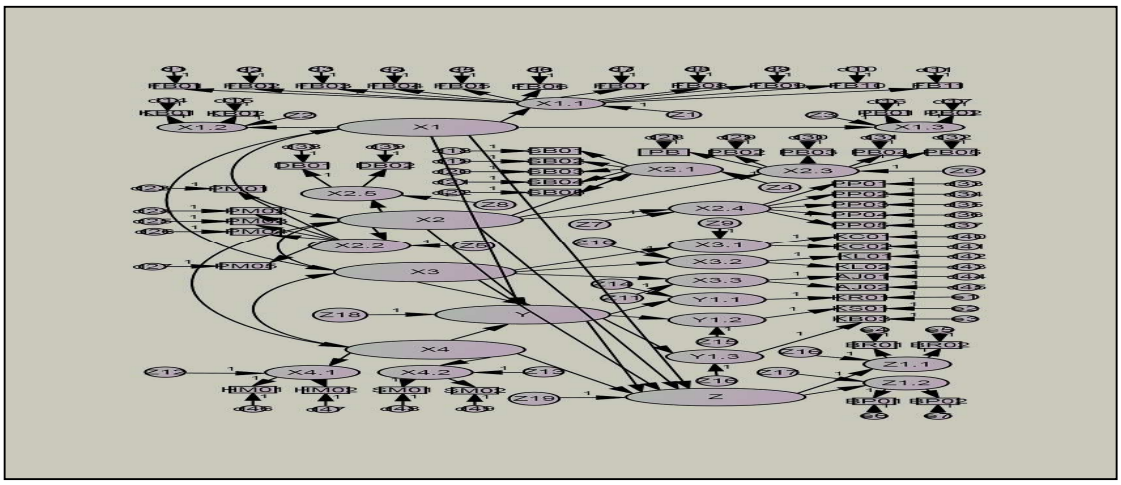
Respondent characteristic taken is based on, [26] [27] [28]:

a. Education (SMA/Vocational Schools, D3, S1, S2, S3).
b. Work experience (<10 years, ≥ 10 years, > 15 years).
c. Occupation (official head, area head, section head, staff, commitment maker official, activity technical implementer official, and project supervisor).

This research respondent is 250 people.

4. Population and Sample of This Research
   This research object is state ownership building constructions in North Sumatera Province as much as 80 building construction. The population is local government official in North Sumatera Province, the user of goods/service in North Sumatera Province and society in North Sumatera Province. In addition, this research sample is 250 people, [29].
5. This Research Variables
   Exogenous variables group is:
   a. State Building Construction Physical (X1) with 3 dimension, that are, construction complexity construction fazed, and construction user.

b. maintenance management of state building constructions (X2) with 5 (five) dimension, that are, construction maintenance and treatment management system, procedure and method of maintenance and treatment work, periodic investigation of building maintenance and treatment, equipment and tools of building maintenance and treatment, building maintenance and treatment documentation.
c. Environment conditions at around state building construction (X3) with 3 dimensions, that are, Weather and Climate Condition at around the building, environment health and access way to construction location.
d. Working unit price (X4) with 2 dimensions, that are, material/matter price determined by local government and material /matter specifications.
e. At this research, the intervening variable is constructions damage level (Y) and have 3 dimensions, that are, light damage, medium damage, and heavy damage.
f. Dependent variable Z (construction maintenance cost at APBD) which have 2 dimensions, that are maintenance cost, repairing cost (renovation and rehabilitations).



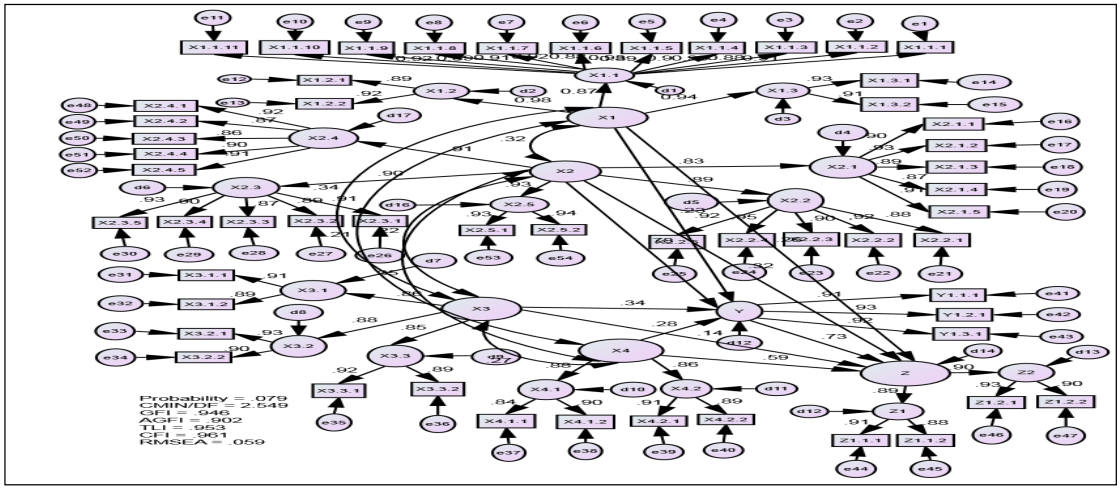
Source: Result of research engineering

Figure 4. Research Structural Model

6. Research Structural Model
Data collections result is processed by AMOS version 21.0. At *Structural Equation Modelling* (SEM) based on covariance, [30].

RESULTS AND DISCUSSION

1. Modelling result with AMOS version.21.0



Source: Result of research engineering with *Software* AMOS *version*. 21.0

Figure 5. Result of Model with AMOS version. 21.0

2. Model acceptance criteria

Table 1. Model Acceptance Criteria

No.	Goodness Of Fit Index	Test Result	Cut Off Value	Criteria
1.	Probability.	0,079	> 0,05	Fit
2.	CMIN/DF.	2,546	< 5	Fit
3.	GFI.	0,946	> 0,90	Fit
4.	AGFI.	0,902	≥ 0,90	Fit
5.	TLI.	0,953	≥ 0,95	Fit
6.	CFI.	0,961	≥ 0,95	Fit
7.	RMSEA.	0,059	≤ 0,08	Fit

Source: Result of research engineering with *Software* AMOS *version*. 21.0

The result above shown that the model proposed had been accepted because was supported by field empirical data

3. *Squared Multiple Correlations* (R^2).

Table 2. *Squared Multiple Correlations* (R^2).

Variable	Estimate
Y	0.426
Z	0.706

Source: Result of research engineering with *Software* AMOS *version*. 21.0

4. Direct effects, Indirect effects, and Total effects.

Table 3. Direct Effects (*standardized direct effects*)

Variable	X1	X2	X3	X4	Y	Z
Y	0,23	0,78	0,34	0,28	0,000	0,000
Z	0,26	0,32	0,14	0,59	0,73	0,000

Source: Result of research engineering with *Software* AMOS *version*. 21.0

Table 4. Indirect Effects (*standardized indirect effects*)

Variable	X1	X2	X3	X4	Y	Z
Y	0,000	0,000	0,000	0,000	0,000	0,000
Z	0,168	0,569	0,248	0,204	0,000	0,000

Source: Result of research engineering with *Software* AMOS *version*. 21.

Table 5. Total Effects

Variable	X1	X2	X3	X4	Y	Z
Y	0,23	0,78	0,34	0,28	0,000	0,000
Z	0,428	0,889	0,388	0,794	0,73	0,000

Source: Result of research engineering with *Software* AMOS *version*. 21.

CONCLUSION

1. *Squared Multiple Correlations* (R^2) are seen at 42.6%, construct proportion of the damage level of the state building constructions (Y) can be explained by physical construct of the state building constructions (X1), maintenance and treatment management of the State Building Construction (X2), Environment conditions in around State Building Construction (X3), and Unit Price of Building maintenance and treatment working (X4). The remains as big as 57.4% are explained by other constructs that are not yet researched.
2. Direct effects (*Standardized direct effects*) are found that:
   a. State Building Construction Maintenance and treatment management (X2) has the biggest direct effects toward State Building Construction damage level (Y).
   b. Working Unit Price (X4) has the biggest direct effects toward maintenance cost at APBD (Anggaran Pendapatan dan Belanja Daerah).
   c. State Building Construction damage level (Y) also has the biggest direct effect toward maintenance cost at APBD (Anggaran Pendapatan dan Belanja Daerah. Z).
3. State Building Construction maintenance and treatment management has the biggest indirect effects toward construction maintenance cost at APBD (Anggaran Pendapatan dan Belanja Daerah, Z) through damage level of State Building Construction (Y).

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