Risk Identification in Residential Construction Project: A Systematic Literature Review

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1. INTRODUCTION

Risk is a measure of the probability and consequence of not achieving a defined project goal (PMBOK in (Kerzner, 2017)). Risk can be distinguished to several types according to the opinion of experts. According to (Petr, 2017) there are three categories of risks:

1. Internal risk
   Internal risk in project construction like resource risk, project member risk, stakeholder’s risk, designer risk,
contractor risk, subcontractor risk, supplier risk, team risk, construction site risk and documents and information risk

2. External risk
External risk are those that risk is beyond the control of project management team like political risk, economic risk, social risk, and weather risk

3. Project Risk
Project risk construction criteria is time risk, cost risk, work quality, construction risk, and technology risk.

The three categories above are divided into two categories: (a) Technical risk; relates to the assessment of the likelihood that the system embodied in the design when it is built meets the performance requirements, (b) Non-technical risks; is a risk that can affect a particular project directly, the cause of which is an unplanned and unintended event that results in unwanted deviations.

According to PMBOK (Kerzner, 2017), Risk management is the act or practice of dealing with risk. It includes planning for risk, identifying risks, analyzing risks, developing risk response strategies, and monitoring and controlling risks to determine how they have changed.

Risk management has become more vital for the completion of residential building construction projects due to the increased complexity and the use of modern equipment and techniques (Hedaoo & Pawar, 2021).

Purpose of this journal is to understanding risk factors in a residential construction project spread over several countries, with various project size and complexity, and to get up to date research information.

2. RESEARCH METHOD
The methodology used in this journal is a literature review of various studies that discuss risk identification and risk management in residential construction projects. In this journal, a risk assessment was conducted which was divided into 3 (three) categories that is: (a) Internal risk, (b) Project Risk, and (c) External Risk. Three categories above is further divided into two parts: (a) Technical Risk and (b) Non-technical Risk.

This journal will review 40 selected journals from year 2012 to 2022. The study framework carried out in this research are as shown in Fig. 1.

3. RESULTS AND DISCUSSION
Table 1 explain about literature review of 40 journals mentioning about risk factors in residential construction projects. Risk factors are classified into three parts, namely internal factors, projects, and external factors. Each risk factors are further divided into Technical Risk (T) and Non-technical Risk (NT). The result of each journal is shown on the right side.
Start

Collecting paper from Google Scholar, ASCE Library, Science direct, Researchgate, etc.

Selecting paper based on keywords

Make an outline from each selector paper.

Classify each paper into:

- **Internal risk**
  - Technical risk
  - Non Technical risk

- **External risk**
  - Technical risk
  - Non Technical risk

- **Project risk**
  - Technical risk
  - Non Technical risk

Result and Conclusion

Finish

Fig. 1. Research flowchart
### Table 1. Summary of literature review of risk analysis in residential construction projects

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<tr>
<th>No</th>
<th>Journal Identify</th>
<th>Internal T</th>
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<th>Project T</th>
<th>Risk Category</th>
<th>Type of Risk</th>
<th>Result</th>
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</table>
| 1  | (Dusane & Bhangale, 2014). India | √ | √ |  | Financial, Time, Regulatory | According to the survey questionnaire, top four highest risk factor are:  
  - Project completion risk,  
  - Delay in construction project risk,  
  - Financial risk,  
  - Regulatory and administrative risk. |
| 2  | (Razali & Manaf, 2014): Malaysia |  | √ | √ |  | Financial, Time | Property development is generally considered to be a high risk business.  
- Any risk for extended the time of the project had the effect of delaying the income and increasing finance costs. |
| 3  | (Fergany et al., 2019): Egypt |  | √ | √ |  | Financial, Material, Construction, Time | According to the survey questionnaire, the top five most important risk factors in residential projects are:  
  - Exchange rate fluctuation,  
  - Fuel price,  
  - Change of labor cost,  
  - Material delivery delay,  
  - Change in design |
| 4  | (Mahendra et al., 2014): India | √ |  |  | Financial, Construction | 57% respondents says that inadequate site investigation create major impact on construction project.  
  - In case of technical risk, inadequate site investigation and incomplete design is statistically significant.  
  - In case of financial risk, inflation and local taxes are correlated to each other. |
<p>| 5  | (Phawchamnan &amp; Nathapindhu, 2018): Thailand. | √ | √ | √ | Health and Safety, Construction | Beverages contains alcohol is a diuretic that can cause dehydration which gets worse while working, result in the increase the risk of accidents. |</p>
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<tr>
<th>No</th>
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<td></td>
<td></td>
<td>Internal T</td>
<td>External T</td>
<td>Project T</td>
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<tr>
<td>6</td>
<td>(Fernández-Valderrama et al., 2019), Espanyol.</td>
<td>√ T</td>
<td>√ NT</td>
<td>NT</td>
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<tr>
<td>7</td>
<td>(Juri &amp; Brajkovi, 2010), Croatia.</td>
<td>√ T</td>
<td>√ NT</td>
<td>NT</td>
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<tr>
<td>8</td>
<td>(Ling Jia, Queena K. Qian, Frits Meijer, 2021), China.</td>
<td>√ T</td>
<td>√</td>
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</table>

Among the risk variables that are part of the model, it is noteworthy for the indices marked by the experts:

- The importance of the finishing materials and construction systems to be used on the building’s facades,
- Planning subsequent maintenance of the building focused on reducing corrective actions,
- Technical suitability of the agents involved in the design,
- Direction and execution of the works,
- This journal presents a model as a solution for financing new housing projects, or refinance existing projects and increase sales with existing and newly built residences, by proposing a model that could better insure investors against underinvestment risk.
- Investor are more likely to refinance existing building loans on unsold properties, than to foreclose and sell without loan support, which is based on a long-term lease with the transfer of title to the property to the lessee at the end of the loan contract period.
- The key risks associated with homeowners and contractors are involving:
  - Cooperation and Performance,
  - Opportunism,
  - Professional expertise, construction management,
  - Safety management, and maintenance.
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<tr>
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| 9  | (Na Ayudhya & Kunishima, 2019), Thailand. | Internal: T External: NT | Project: NT | Time, Quality, Construction. Ten highest risk factor which have impact to performance of management in residential projects are:  
- Operational errors,  
- Payment delays,  
- Design errors,  
- Operating cost fluctuation,  
- Delay of development process,  
- Interest rate,  
- Natural disaster,  
- Employment fluctuation,  
- Instability in politics  
- Changes in legislation |
| 10 | (Simanjuntak & Salim, 2020), Indonesia. | Internal: T External: NT | Project: NT | Time, Quality, Construction. Variable of delay risk identified as:  
- Design factor; delay of design approval, lack of integration and design coordination,  
- Construction factor; poor field management, poor quality of work.  
- Procurement factor; financial problems experienced by the owner. |
| 11 | (Hosein & Ray, 2020), Trinidad & Tobago | Internal: T External: NT | Project: NT | Financial, Quality, Time, Construction  
The most prioritized risk parameters are:  
- Availability of direct labor,  
- Engineering designs,  
- Availability of materials,  
- Project scheduling,  
- Project management |
The possibility of management to finish a construction project (as it estimated by CPM-PERT):  
- in 197 days is 62.04%,  
- in 204 days is 95%.  
While 100% timeliness possibility can be obtained in minimum 209 days.  
The main causes of risk in real estate projects are:  
- Government regulations and licensing entities,  
- Inadequate suppliers experience,  
- Inexperienced project team. |
<p>| 13 | (Pereira et al., 2020), Portugal. | Internal: T External: NT | Project: NT | Quality, Construction |</p>
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<tr>
<th>No</th>
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<tbody>
<tr>
<td>14</td>
<td>(Eric Cahyadi Halim, Andi, 2021), Indonesia.</td>
<td>✓ Internal</td>
<td>✓ External</td>
<td>Quality, Construction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Project NT</td>
<td></td>
<td>Top 5 sub-dominant factors that can cause delays in residential construction projects using metode Interpretive Structural Modeling (ISM);</td>
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<td></td>
<td></td>
<td>✓ Type NT</td>
<td></td>
<td>- Design changes during construction</td>
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<td></td>
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<td>- Late delivery of materials</td>
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<td>- Delay in approval of working drawings</td>
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<td></td>
<td></td>
<td></td>
<td>- Late payments</td>
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<td></td>
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<td></td>
<td></td>
<td>- Inappropriate work methods</td>
</tr>
<tr>
<td>15</td>
<td>(Tiwari et al., 2019), India.</td>
<td>✓ Internal</td>
<td>✓ External</td>
<td>Quality, Construction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Project NT</td>
<td></td>
<td>The most common risk factors allocated to contractors and owners (Share Risk Factor) are:</td>
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<td></td>
<td></td>
<td>✓ Type NT</td>
<td></td>
<td>- Poor communication between involved parties</td>
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<td>- Legal disputes during construction among the parties of the contract</td>
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<td>- Adverse weather conditions</td>
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<td>- Delayed disputes resolutions.</td>
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<td>- Actual quantities differ from the contract quantities</td>
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<td>- No specialized arbitrators to help settle fast</td>
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<td></td>
<td></td>
<td></td>
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<td>- Supplies of defective materials</td>
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<td></td>
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<td></td>
<td>- Fear of political interference</td>
</tr>
<tr>
<td>16</td>
<td>(Badawy et al., 2022), Egypt.</td>
<td>✓ Internal</td>
<td>✓ External</td>
<td>Financial, Construction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Project NT</td>
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<td>Four risk factors affecting the overall risk were identified at an early stage:</td>
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<td></td>
<td></td>
<td>✓ Type NT</td>
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<td>- The implementation of risk management processes,</td>
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<td></td>
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<td>- The contract cost,</td>
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<td></td>
<td></td>
<td></td>
<td>- Contract type,</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>- The project duration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓ Project NT</td>
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<td>This study developed 24 indicators of the planning process, resulting in identification of 62 housing planning processes with 94 risk factor.</td>
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<td>No</td>
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<td>Type of Risk</td>
<td>Result</td>
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</table>
| 18 | (Hedaoo & Pawar, 2021), India. | Internal T External NT | Quality, Construction | The study using a fuzzy approach with MATLAB software, to identify top ten risk factors affecting construction projects of residential buildings:  
- Resource management  
- Payment delays by owner  
- No clear scope of project at the beginning  
- Escalation of material prices  
- Design changes  
- Inadequate data collection and surveying prior to design  
- Lack of specialised staff  
- Improper planning of construction activities  
- Regulatory approval  
- Lack of coordinating ability |
| 19 | (Murtala et al., 2013), Nigeria. | Internal T External NT | Financial, Construction. | The purpose of this research is to develop a Neural Network Econometric Entropy Based Project Adjudication Model for Residential Building Project Procurement. |
| 20 | (Khaleel & Flayeh, 2020), Iraq. | Internal T External NT | Quality, Construction. | This journal investigated the application of risk management as a systematic methodology in residential complex projects, resulting a total of 57 risk factors. |
| 21 | (Wali & Othman, 2019), Iraq. | Internal T External NT | Quality, Construction. | The objective of this study is to analyzes the output of a project schedule risk simulation using Monte Carlo. Results of study are:  
- Low risk project duration equal to 103 days,  
- Base risks project duration equal to 107 days  
- High risk project duration equal to 111 days. |
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<tbody>
<tr>
<td>22</td>
<td>(Azarova, 2015), Rusia.</td>
<td>Internal T, NT</td>
<td>Quality, Construction</td>
<td>The results of this study is a suggestion that can be used in the management of construction investment housing construction projects to estimate their values, analysis of stakeholder interests to establish a balance the interest and project risk, related to the difference between the project objectives and the interests of its stakeholders.</td>
</tr>
<tr>
<td>23</td>
<td>(Subramanian et al., 2014), US</td>
<td>Internal T</td>
<td>Environment</td>
<td>The results provide new insights for building the next generation of fragility-curve models for accurately predicting hurricane wind damage risk to residential structures at the spatial scale of 1-km² blocks.</td>
</tr>
<tr>
<td>24</td>
<td>(Li &amp; Ellingwood, 2009), US</td>
<td>Internal T</td>
<td>Environment</td>
<td>Cost effective risk mitigation efforts for wood-frame residential construction should be targeted on those construction practices that are most likely to reduce severe losses under low-probability design events of hurricane and earthquake hazards.</td>
</tr>
<tr>
<td>25</td>
<td>(Lopez del Puerto et al., 2014), US</td>
<td>Internal T</td>
<td>Health and safety</td>
<td>The safety culture in the residential sector appears least supportive and effective compared to commercial and heavy civil sectors. Such a culture may lead to decreases in communication and incorrect assumptions that may influence decision making and contribute to disproportionately higher rates of injuries and fatalities in residential construction.</td>
</tr>
<tr>
<td>26</td>
<td>(Walsh et al., 2004), US</td>
<td>Internal T, NT</td>
<td>Financial, Material</td>
<td>Risk transfer provided a potentially significant revenue stream to the framer/lumber yard, and indicated that the home builder would experience lower costs by maintaining cost transparency.</td>
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<td>No</td>
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<td>Type of Risk</td>
<td>Result</td>
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<tr>
<td>27</td>
<td>(Shahapur &amp; Balasaheb, 2016). India</td>
<td>Internal T</td>
<td>Financial, Management, Material, Socio-politic, Regulatory, Construction, Environment</td>
<td>Risk Management is taken as one of the toughest sector of the construction process and its application has to be encouraged in all the projects to avoid negative consequences in the project.</td>
</tr>
<tr>
<td>28</td>
<td>(Abdulrahman, 2019). Iraq</td>
<td>Internal T</td>
<td>Financial, Regulatory</td>
<td>The majority of construction contractors in Iraq have lack in knowledge or ability about how to employ risk management in their projects and specially what relating to how to identify, analyses and manage risks.</td>
</tr>
<tr>
<td>29</td>
<td>(Mehta et al., 2019). India</td>
<td>Internal T</td>
<td>Financial, Time, Quality, Contract, Material, Socio-politic, People, Construction, Environment</td>
<td>The research journal is aimed at fostering the use of fuzzy logic system in the construction industry.</td>
</tr>
<tr>
<td>30</td>
<td>(Aarthipriya et al., 2020). India</td>
<td>Internal T</td>
<td>Time, Material, Management, Construction</td>
<td>The results show that the by the probability of 80%, the original duration is 91 days. By incorporating risks, the pre-mitigation duration increases tremendously to 181 days. After applying post-mitigation plan, the duration is decreased to 161 days.</td>
</tr>
<tr>
<td>31</td>
<td>(Mishra &amp; Mallik, 2017). Egypt</td>
<td>Internal T</td>
<td>Time, Financial, Quality, Construction, Contract, Health and Safety, Environment, People, Management</td>
<td>More than 80% of respondents at Kathmandu valley believe that their top management are highly aware regarding the risk management. Generally they are found to be focused on risk of scheduled time and cost.</td>
</tr>
<tr>
<td>32</td>
<td>(Bhadane et al., 2021). Nepal</td>
<td>Internal T</td>
<td>Time, Financial, Quality, Construction</td>
<td>This journal focuses on risk analysis in a residential building construction project. Various methods to perform qualitative risk analysis are stated in detail. Out of which probability-impact matrix method is generally used for housing projects.</td>
</tr>
<tr>
<td>No</td>
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<td>33</td>
<td>(Haq, 2019), India.</td>
<td>Internal T NT</td>
<td>Financial, Material, Management, People, Construction, Environment</td>
<td>Scope and Financial risks are the top most serious risks. Risks affecting on the scope of the project are the most critical risks affecting budget and schedule of the project.</td>
</tr>
<tr>
<td>34</td>
<td>(Phadtare et al., 2018), India.</td>
<td>Internal T NT</td>
<td>Material, Health and Safety</td>
<td>Three types of risk management strategies are found relevant in small construction firms undertaking repairs and modernization of residential houses namely: • Risk retention, • Risk sharing • Risk prevention</td>
</tr>
<tr>
<td>35</td>
<td>(Lee et al., 2018), Switzerland.</td>
<td>Internal T NT</td>
<td>Quality</td>
<td>Loss distributions can be used to create scenarios and corresponding response plans; thus, when a defect dispute occurs, the cost can be assessed.</td>
</tr>
<tr>
<td>36</td>
<td>(Na Ayudhya &amp; Kunishima, 2017), Thailand.</td>
<td>Internal T NT</td>
<td>Time, Quality, Construction, Environment, Management, Sosio-politic</td>
<td>• This journal examines the list of risks of abandonment of housing development projects caused by subcontractors in Bangkok and surrounding area • The result show that delays in interim payments, financial difficulties faced by owners, financial difficulties faced by incompetent contractors, contractors or subcontractors, political instability are the most important factors that cause subcontractors to leave housing projects.</td>
</tr>
<tr>
<td>37</td>
<td>(Gurcanli et al., 2015), Turkey.</td>
<td>Internal T NT</td>
<td>Financial, Construction, Health and Safety</td>
<td>Safety management is one of the most prominent elements of construction management.</td>
</tr>
<tr>
<td>No</td>
<td>Journal Identify</td>
<td>Risk Category</td>
<td>Type of Risk</td>
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</tr>
<tr>
<td>38</td>
<td>(Isaza-Restrepo et al., 2016), Columbia.</td>
<td>T NT ✓ ✓</td>
<td>Environment, Construction</td>
<td>• This journal provides a quantitative assessment of hazards, vulnerabilities and risks using the methodology and numerical with the FOSM technique and Rosenblueth point estimation. • It is recommended to reduce the probability of annual erosion failure to 0.001% when the associated risk is 100 deaths. Projects that present a risk above this value will not be accepted.</td>
</tr>
<tr>
<td>40</td>
<td>(Prakash et al., 2017). India.</td>
<td>✓ ✓ ✓</td>
<td>Management, Construction</td>
<td>This journal describes the step by step process involved in risk management and analyzing the various identified risk factors using the fuzzy logic tool box in the MATLAB software.</td>
</tr>
</tbody>
</table>

Based on Table 1 above, there are some information that can be extracted. Fig. 2 shows publication by the country of researcher (India, Indonesia, Thailand, Iraq, China, Turkey, Malaysia, Russia, Nepal, Switzerland, Trinidad & Tobago, Portugal, Croatia, United States and Colombia). Research journals from India are the first to rank the most risk assessments on residential projects, then Indonesia, the United States ranks third.

Based from the table 1 above, six risk categories have been classified as illustrated in Fig. 3, where External Non-Technical Factors ranks first risk factors in residential projects, followed by Internal-Techinion in second place and Internal Non-Technical in third.
Also from the table 1 above, types of risks in the construction of different residential project buildings are summarized. As shown in Figure. 4, all these types of risk are classified into 10 categories, of which 4 categories of risk types account for the highest percentage:

1. Construction: the construction management plan a major role in the risk of residential projects. Poor project management is the first major contributor to project risk. According to Wang et al., (2014) in the conclusion of his journal stated that safety evaluation of the construction management plan is an important part of the construction safety review. If the safety result of the construction management plan is “ineligible”, the unit supervisor is asked to disapprove the construction management plan, so the Construction Safety Review will not be accepted. That means a good construction management plan is needed to get a better construction management system.

2. Financial: Residential projects and other projects in general, require accurate and precise financial planning and management. If this factor is not carried out, this factor contributes as a significant project risk.

3. Quality: The quality of work is something that reflects the success of the project. The risk of work quality is influenced by the type of material or materials used, labor, and a limited schedule.

4. Time: The percentage of time analysis is basically influenced by several factors such as delays in material delivery, inaccuracy in ordering materials, delays in the payment process by the owner, labor shortages, equipment shortages, design changes and a weak schedule control system.

4. CONCLUSION

From the results of the reviews of several journals that have been described previously, the risk factors in residential projects are generally very diverse and give us an idea that the interrelationships between the parties with an interest in the project contribute to the risk factors themselves occurring in the course of the
project. Reliable construction management is needed in overcoming and minimizing the risks that occur in this project and is the key. Furthermore, no less important is good financial support, so that the project can run according to the plan that has been made.

From several journals that we have researched, it has been mentioned that the risk factors that occur in residential projects are something that is commonplace in various countries, in this case contributing to the success of the project. Certainly with considering that there is still a lot of literature that discusses risks in projects, this needs to be a concern in planning and implementing projects in the future.

We find a success story in the residential construction project after identifying and mitigating risks factor, that risk management as an important component of the project to avoid the probability for project success in good turn.

5. SUGGESTION
Research using the literature review method related to risk factors in a residential construction project is recommended further using case studies on actual project so that the effectiveness of risk management can be analyzed. This is to obtain information about actualization on site related to the risks identification and mitigation that will be carried out on the project.

REFERENCES


https://doi.org/10.15396/eres2006_183


