Investigation of Critical Risk Factors and Level of Risk for Environmentally damage induced by house projects

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ABSTRACT

Expansive market opportunities and attractive profit prospects in the housing development sector encourage many business people to be interested in investing in this sector. The significant number of the risk factors which arise during the housing development process and weaknesses of developers in managing them have resulted in some developers failing to achieve projects goal. This study aims to identify critical risk factors and determine the factors that have the highest level of risk in a housing development project in Semarang, Indonesia. The research was conducted using a structured survey questionnaire. The mean score statistical technique was used in data analysis with SPSS version 26.0 software to determine critical risk factors. The level of risk is determined based on the frequency of occurrence of the risk and the severity of the risk. The results show that there are 26 critical risk factors for housing development projects. The high land acquisition price, unmanaged cash flow and business competition are the factors that have "Very High Risk" level of risk. In addition, there are twenty-one factors with "High Risk" level of risk, and two factor with "Medium Risk" level of risk, which embraces the risk factor for natural disasters as well as utility and material delays. This study contributes to the understanding of the critical risk factors in housing development for housing developers to manage project risks.

Keywords: Environmental Damage, Level of risk, Critical risk factors, House projects.
Article type: Research Article.

INTRODUCTION

The need for housing and shelter increases with the increase in population and the number of new family heads that are formed in the community. Housing needs are also influenced by the number of damaged houses and the backlog or shortage of houses that occurred at the previous time. This has led to increased housing market opportunities, and ever increasing sales prices, prompting many professional and amateur developers to try to make a profit by building and developing housing and marketing it to consumers. The construction industry is highly risk-prone, with a complex and dynamic project environment that creates an atmosphere of uncertainty and high risk (Namitha Sheen *et al.* 2017). Risks and uncertainties, if not managed properly, can have an impact on time overrun, low quality of work, and costs overrun and result in losses and failure of project objectives. Property development is a multi-phased process that involves developing land, followed by housing development and, ending with the marketing stage, which is selling or leasing from a site that has been completed. The three phases of the housing industry are interrelated, each stage involving various risks allocated between the land owner, land developer and house builder (Buttimer *et al.* 2008). Decisions about investing in housing development projects not only consider returns, but also accurately predict risks. Benefits and risks exist at the same time, the greater the benefits, the greater the associated risks (Lin *et al.* 2014). The construction industry is more prone to risk due to the complexity, uniqueness and the sheer number of activities in the project. The struggles and disputes faced by the construction industry due to risks make risk management inevitable. The construction industry requires

large amounts of investment for project implementation, resources, must be put to good use which can be achieved with proper risk management (Prakash *et al.* 2017). The construction industry is often seen as complex and fragmented because it works in a project-based format, with unique products and processes where decisions need to be made with insufficient information. Therefore, a proper risk management process can be vital for minimizing risks, maximizing opportunities, and securing a successful project process (Bonander *et al.* 2016). The main challenge facing real estate developer management is to estimate the magnitude of the risk posed by position holders, as well as to estimate whether management is aware of the risks and whether they apply their knowledge to avoid risks. Top management should investigate the different types of risks in the project and how they can manage risks, through education or past experience and other sources. Knowing how risky a residential developer construction project is always a problem facing many people as it requires knowledge of economics, engineering, mathematics and many more disciplines (Mallik 2017). Correspondingly, developers who are less experienced and do not understand the determinants of success in investment activities, are sometimes unable to deal with problems that occur and fail. The failure of a developer in carrying out its investment will result in losses for many parties involved, including: consumers, suppliers, contractors, land owners, banks and the developer himself. To minimize the occurrence of losses, even failure of housing development projects, developers need to gain knowledge about important risk factors that have the potential to cause housing development failures and how to manage project risks. This research is intended to identify risk factors that exist in housing development projects in the city of Semarang and assess the risk level of each identified risk factor.

Risk identification: The first step in any risk management activity is to identify possible risks. Products resulting from the risk identification process are a list of events that could potentially occur in a project and their risk classification (Szymański 2017). Risk identification is an important process carried out to ensure the success of the project and to meet the project time, cost, quality, and safety. The first place used to identify risk is the project itself. To help identify risks, you can use a list of project constraints, a list of tasks, and the factors that determine the success of the project itself (Cheraghi *et al.* 2017). Identification of risk factors can also be done by literature study and site investigation. There are two sources of risk literature, namely a list of project risks that are similar to the results of previous studies and interviews with experienced practitioners and managers in the related field. Risk analysis and conclusions from previous research can be used to help identify potential risks, and to test the suitability of lists of identified risks with those of projects in a particular area, interviews with professionals and project managers are conducted to produce a risk library (Wang *et al.* 2018). Mistakes in identifying project risks have the potential to increase the total cost, time of project implementation and can cause social, environmental and casualties damage during project implementation (Cheraghi *et al.* 2017). There are some studies about risk assessment in environmentally aspects of financial projects (Alekseevna Fedorova *et al.* 2020; Dmitrievna Sitdikova *et al.* 2020; Voronkova *et al.* 2021; Kitsai *et al.* 2021). Risk identification in this study was carried out in two stages. First, make a list of risk factors for housing development projects that have been carried out by previous researchers. The second conducted interviews with 3 senior housing developer practitioners in the city of Semarang. In this interview, it was conducted to clarify which risk factors were recorded in the list of risks faced by developers in Semarang. The interview also asked for information on whether there are other risk factors that have not been recorded in the list faced by the developer. From the results of the literature study and interviews with stakeholders in housing development in Semarang, it can be identified that there are 26 possible risk factors (Table 1). The 25 risk factors obtained from the literature study and interview results add to a risk factor that has not been studied before. This list of risk factors will be used as a basis for creating a questionnaire in this study.

MATERIALS AND MATHODS
Experimental design
The survey questionnaire that will be distributed is divided into two parts, the first part contains the respondent's profile while the second part contains the risk factors that have been identified in the first stage of data collection. Respondent data includes: Respondent's position in the company, the length of time he worked in the housing development project sector, and the respondent's educational qualifications. The second section contains the risk factors associated with 5 events probability scales (almost certain, possible, possible, unlikely, and rare) and 5 consequences analysis scales (severe, large, moderate, minor and negligible), according to ISO 31000. Respondents asked to select one of 5 probability scales and one consequence scale by ticking each risk factor according to their beliefs.

Table 1. Risk factors of environmentally damage induced by housing project.

No.	Risk Factors	References
1	Existing differences	(Iqbal *et al.* 2015)
2	Delay in permission	(Partamihardja 2016)
3	Consumer contract disputes	(Bon-Gang *et al.* 2018)
4	Changes in government policy	(Mubarak *et al.* 2015)
5	Change of Government officials	(Iqbal *et al.* 2015)
6	Less promotion	(Iqbal *et al.* 2015)
7	The price of the product	(Iqbal *et al.* 2015)
8	The location is not suitable for the market	(Iqbal et al. 2015)
9	Business competition	(Abdul-Rahman *et al.* 2015)
10	Quality assurance	(Rumimper *et al.* 2015)
11	The work method is not quite right	(Bon-Gang *et al.* 2018)
12	Poor subcontractor performance	(Shan *et al.* 2017)
13	The stock house was damaged	Interview
14	Utility and material delays	(Qazi *et al.* 2018)
15	Lack of supervision of subcontractors	(Bon-Gang *et al.* 2018)
16	The price of land acquisition is high	(Abdul-Rahman *et al.* 2015)
17	Unmanaged Cash flow	(Fergany *et al.* 2019)
18	Decreasing market demand	(Bon-Gang *et al.* 2018)
19	Increase in material prices	(Shan *et al.* 2017)
20	Delay in provision of project funds	(Iqbal *et al.* 2015)
21	Less competent project management	(Iqbal *et al.* 2015)
22	Disputes with subcontractors	(Iqbal *et al.* 2015)
23	Lack of coordination in the project	(Bon-Gang *et al.* 2018)
24	Lack of site workers	(Shan *et al.* 2017)
25	Difficulty to access the site	(Shan *et al.* 2017)
26	Natural disasters	(Abdul-Rahman *et al.* 2015)

Risk assessment

Research data from the assessment of housing developer practitioners were obtained from 30 respondents who were practitioners of housing developers in the city of Semarang. They have various educational backgrounds, positions in companies and different work experiences (Table 2). But they all work for real estate development companies. The majority of respondents (47%) hold positions as directors of development companies. This is very profitable in terms of data acquisition because the director is familiar with all the problems and risks faced by the developer. The director is the highest level of company management and decision makers in every company problem. The project leader is a position held by 30% of respondents. This is also very significant for the respondent's knowledge of every risk factor faced by the developer because the project manager is the person who knows most about all the risks faced by developers in the field. Meanwhile, 13% of respondents served as site managers who of course also manage a lot of project work so that they are able to understand the risk factors that exist in the project and are accustomed to managing them. 10% of respondents are HRD, which is a part of research

and development related to the company. In terms of educational background, the majority of respondents (60%) are bachelor and 27% have a master's background. A high educational background will show the respondent's ability to understand and analyse the questions raised in the questionnaire, and will be able to answer correctly. The right respondents will produce accurate study data. Judging from the experience of working on housing development projects, 57% of the respondents have worked for more than 5 years, 27% have worked for more than 10 years and 10% of respondents have more than 15 years of work experience. Sufficient project experience will lead to the realization of respondents who have adequate capabilities in answering the questions in the questionnaire. So that the answer to the question will be understood and will provide the correct answer. In this study, after risk identification was carried out, risk was assessed in terms of its possible severity, magnitude of potential loss and likelihood of its occurrence. The level of loss can be measured by calculating the value of the building lost, the cost loss that must be incurred, and the additional time required. In terms of probability, it is assessed from an event that is unlikely to occur to events that always occur. Therefore, in the assessment process, it is very important to make the best guesses so that they can be prioritized correctly (2010) .The average index is used to determine the opinion of experts in assessing the probability and impact of each risk factor.

Table 2. The background of the respondent.

A.	Position in the Company	Rate (%)
	Director	47%
	Project Manager	30%
	Site Manager	13%
	HRD	10%
B.	Education background	Rate (%)
	High School	3%
	Diploma	10%
	Bachelor	60%
	Master	27%
C.	Work experience	Rate (%)
	1 – 5 years	43%
	6 – 10 years	30%
	11 – 15 years	17%
	16 – 20 years	7%
	>20 years	3%

Table 3. The relative important index (Source: ISO 31000).

Consequences Scale	Probability Scale				
	Rare (1)	Unlikely (2)	Possible (3)	Likely (4)	Almost Certain (5)
Severe (5)	5	10	15	20	25
Major (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	15
Minor (2)	2	4	6	8	10
Negligible (1)	1	2	3	4	5

Table 4. Risk category.

Risk Category	Low	Medium	High	Very High
Important Index	1.00 – 4.00	4.01 – 8.00	8.01- 12.00	>12

The level of risk is proportional to each of the two components (consequences or likelihood), the risk function is basically a product. This can be displayed mathematically as:

Risk = Consequences × Possibility (R = C × L)

Because the C and L scales are from 1 to 5 respectively, you will get the lowest R scale is 1, while the highest is 25.

Table 5. Risk assessment.

Ranking	Risk Factors	C	L	R	Category
1	The price of land acquisition is high	3.97	3.63	14.41	Very High
2	Business competition	3.83	3.43	13.14	Very High
3	Unmanaged Cash flow	3.73	3.47	12.94	Very High
4	The stock house was damaged	3.70	3.10	11.47	High
5	Delay in permission	3.33	3.37	11.22	High
6	The price of the product	3.40	3.30	11.22	High
7	Consumer contract disputes	3.40	3.27	11.12	High
8	Change of Government officials	3.13	3.50	10.96	High
9	The location is not suitable for the market	3.03	3.60	10.91	High
10	Less promotion	3.23	3.37	10.90	High
11	Quality assurance	3.30	3.27	10.79	High
12	Existing differences	3.33	3.17	10.56	High
13	Decreasing market demand	3.10	3.30	10.23	High
14	Difficulty to access the site	2.90	3.50	10.15	High
15	Delay in provision of project funds	3.07	3.30	10.13	High
16	Lack of supervision of subcontractors	3.13	3.07	9.61	High
17	Changes in government policy	2.87	3.33	9.56	High
18	Poor subcontractor performance	3.37	2.73	9.20	High
19	Less competent project management	2.90	3.17	9.19	High
20	The work method is not quite right	2.97	3.07	9.12	High
21	Increase in material prices	2.90	3.00	8.70	High
22	Lack of coordination in the project	3.17	2.73	8.65	High
23	Lack of site workers	2.97	2.77	8.23	High
24	Disputes with subcontractors	2.77	2.90	8.03	High
25	Natural disasters	1.73	4.23	7.32	Medium
26	Utility and material delays	2.33	2.63	6.13	Medium

Table 3 illustrates the process and description that might be used to combine the level of consequences with the level of likelihood to determine the level of risk. The number of risk categories defined in this table reflects the needs of the study to be carried out. The risk category is associated with the recommended level of management attention or the requested response time scale. For example: (a) Very high or high risk: senior executive management attention is needed, action plans and management responsibilities are determined. (B) Medium risk: managed by monitoring or certain responsive procedures, with specified management responsibilities. (C) Low risk: routinely managed procedures, may not require the application of specific resources.

DISCUSSION

There are 26 risk factors in a housing development project in Semarang (Table 5) and there are 3 risk factors that have the highest risk level, namely the high land acquisition price with a value of R = 14.41, business competition (R = 13.14) and cash flow that is not well managed (R = 12.94). These three risk factors have the highest

probability of a risk event compared to other risk factors and are followed by the worst impact. Purchase of land in housing development is the biggest expense that must be incurred by the developer at the beginning of the project. The price of land will determine how much the cost of the project being developed and determine the price of the product to be developed. The high land price will cause the overall project cost to be high and the product price for each housing unit offered to be expensive. The high price of the product will limit the number of buyers who can afford the product. The limited number of buyers will cause product sales to stall and take a long time. This will cause the company's cash flow to develop not smoothly and even the developer is threatened to stop its activities if it runs out of cash because expenses continue to occur but there is no income. In a study conducted in Mataram by Mubarak *et al.* (2015), the high land acquisition price factor is a risk factor in the high risk category with a value of R = 12. This confirms that the high purchase price of land is indeed a very significant risk factor for the success of housing development projects.

Tight business competition between developers will be very dangerous for new and inexperienced developers. The sharp competition for the market makes each developer perform marketing manoeuvers with the best strategy in capturing consumer interest in buying their products. Developers who do not master the right strategy, who do not conduct a feasibility study at the start of the project, and do not assess the target market will fail to sell. As a result, they will wait for long sales deals or even no one buys the product. This condition will result in developers running out of financial resources and experiencing investment failure. One of the causes of the inability to win the market and failing in business competition is the mistake in determining the cost of purchasing land so that the purchase becomes too expensive. In a study conducted by Partamihardja (2016), the business competition factor is also a risk factor that has a very high risk level (R = 13.96). The results of the study conducted in Semarang reinforce the conclusion that the developer's ability to face business competition among housing developers is a very determining factor for the success of investing in housing projects. Inability to manage finances is a risk factor in the Very High risk category. Companies that fail to make a profit but still have cash can continue to run their business while improving their performance so that they can return to profit. However, companies that are not able to manage finances properly will run out of cash and fail to meet their short-term obligations, such as failing to pay workers, material debt, not paying contractors, and being unable to pay operational costs. This will cause the production process to stop due to the loss of workers, suppliers and company operations to a halt. When the development company is no longer able to carry out its business activities, the company fails to achieve its project investment objectives. This study is somewhat different from other studies conducted by Fergany *et al.* (2019). The factor of inability to manage cash flow is included in the medium category, but in his study, they divided the risk level category into only three scales, namely low, medium and high. These three risk factors with a very high category risk level can be interrelated factors. The high purchase price of land will cause the price of the product being offered to be very high. The high price of the product offered will reduce competitiveness in product sales in the market. The high cost of land will also absorb very large supplies at the beginning of the project, making it dangerous for the company if the availability of project operational funds is minimal. The inability to manage finances with minimal availability of funds will threaten instability in the project. The three factors with very high risk categories require the attention of senior executive management. Risk management planning and who is responsible must be determined from the start of project activities or at the project planning stage. Carelessness in risk management planning will have a fatal impact and will result in substantial losses. The study results stated that 21 risk factors were categorized as high risk with R values ranging from 8.03 to 11.47. These risk factors are the stock house was damaged, delay in permission, the price of the product, consumer contract disputes, change of government officials, the location is not suitable for the market, less promotion, quality assurance, existing differences, decreasing market demand, difficulty to access the site, delay in provision of project funds, lack of supervision of subcontractors, changes in government policy, poor subcontractor performance, less competent project management, the work method is not quite right, increase in material prices, lack of coordination in the project, lack of site workers, and disputes with subcontractors. What is interesting in this study is that there is one risk factor in a housing development project that has not been studied in previous studies, namely the stock house was damaged. This risk factor has the highest ranking among the risk factors in the high risk category with a value of R = 11.47. The inventory of damaged housing units will burden the company's finances because it requires several steps to handle which have an impact on additional costs and time. Damage to the stock house building will require dismantling the damaged part, procuring materials and repairs. This will result in delays in sales transactions for damaged housing units, and additional repair costs that

may exceed the expected profit. Repair of damaged housing units has caused direct losses to the developer. The more inventory units that are damaged, the heavier the company will bear the repair costs. The delay in obtaining housing development permits from the local government is a critical problem. A development permit that has not been obtained by the developer will make all development activities at the site not yet legitimate and considered to be illegal. In this study the delay in obtaining a development permit was categorized as high risk. This is reasonable because all the financing and investment made by the developer has not yet been able to generate revenue. Even though general facilities have been built and housing units already exist, they cannot be bought and sold. Delays in obtaining permits will hamper the development process and also prevent developers from getting sales results. In the study conducted by Partamihardja (2016), and Mubarak *et al.* (2015), this risk factor is also classified as a high risk category. Thus the developer management team must pay attention to this risk factor by making a stronger effort to get a development permit before the project starts.

The high selling price of the product will reduce the competitiveness of the developer. As a result, sales are slow and can further disrupt the company's cash flow. Respondents in this study argue that this risk factor is in the high risk category (R = 11.22) and the developer must pay serious attention to this factor long before the project starts. During the project feasibility study process, the developer must carefully examine the pricing of the product to be marketed. In a previous study, Partamihardja (2016) concluded that this factor is classified as a high risk category in a housing development project. There are similarities in determining the product price factor category in this study with that of Partamihardja (2016). Consumer contract disputes are disputes between developers and consumers due to differences in perceptions of work quality, payment patterns, product delivery times, product value and so on. This dispute resulted in a decrease in the level of consumer confidence, cancellation of purchases, delays in payments, which resulted in delays in sales. This risk factor is included in the high risk category in the housing development project in the city of Semarang. Mubarak who conducted a study in Mataram City also included this risk factor in the high risk category (Mubarak et al. 2015), but in the research in Banyumas district conducted by Partamihardja (2016), it was in the medium category. The occurrence of a change in government officials, in general, will be followed by changes in regional policies, including those related to housing development, which have implications for the cost and time for developers to adjust to the new regulations. This factor is included in the high risk category, so the developer needs to anticipate it if during the project period it is possible to change the regional head. The location is not suitable for the market and it belongs to the high risk category. A less strategic location in the eyes of consumers will lead to low buyer attractiveness and low sales. As a result, it took longer to complete the housing development project, and it cost more. Unlike Semarang, the research was conducted in Mataram City (Mubarak *et al.* 2015) and Banyumas district (Partamihardja 2016), this risk factor is included in the medium risk category. Lack of promotion is a factor that occurs due to the developer experiencing financial constraints, ignorance of the importance of promotion or because the developer trusts the marketing team too much. An intense promotion will require large costs and a little promotion will be more economical, but with a little promotion, there will be few potential customers who know about the project being developed, so that it will have an impact on the number of consumers who come and low sales rates. As a result, the investment time is long and the project costs are greater. The results of the study in this research determined that this risk factor was included in the high risk category, as did Partamihardja (2016). However, Mubarak (2015) classified it into the medium risk category. Consumers need to be guaranteed that the home products purchased are of good quality. By providing quality assurance to consumers, consumers will be interested and buy at that location. Meanwhile, without a guaranteed product quality, consumers are reluctant to buy for fear of not getting a quality house. Quality assurance will make developers careful in choosing contractors, executors, procurement of materials and work tools to obtain quality products. The implication of this is that the developer will spend more. As in the study conducted by Partamihardja (2016), in this study, quality assurance is in the high risk category. Differences in field conditions with those described in the planning will result in the need for a new design in accordance with field conditions or the need for additional construction in accordance with the existing location. This will result in the need for additional time and cost for project implementation. The occurrence of this condition results in the need for additional time and costs than previously planned. Decreasing factors in market demand are economic, political and social conditions which result in decreased purchasing power which causes consumers to delay or cancel home purchases. This will threaten the company's cash flow and lead to excess time. Selection of land with poor access constraints, narrow, far from roads, or poor subgrade conditions causes difficulties in accessing the project location, both during delivery of equipment, materials and mobilization

of labor. Poor access also makes potential customers reluctant to come to see the location. In this study, difficulty access is included in the high risk category, but in the research conducted by Mubarak *et al.* (2015), Rumimper *et al.* (2015), and Fergany *et al.* (2019) this factor is in the medium risk category. The delay in providing project funds is a very unfavourable situation. The causes of this condition are, among others, failure to obtain financing from banks, investors experiencing financial difficulties which hamper project financing. If there is a delay in project funding, the project implementation will be postponed. Lack of supervision of subcontractors occurs due to the developer not hiring a supervisory consultant, limited costs, a lack of a developer team working in the field, or because the contractor is highly trusted by the developer. This results in low control over the contractor's work. If the contractor makes a mistake in handling the work, it will take a long time to detect and fix it will be more difficult or will be expensive. Changes in government policy will cause the developer to follow the new rules, make the necessary changes and have to finance the required changes. Poor subcontractor performance occurs due to the developer carelessly selecting subcontractors. This can result in poor quality work, repairs and repetitions of work, and close supervision. Less competent project management will result in the project not being managed properly. This will cause problems so that construction projects can be hampered by completion and cost overrun occurs. Working methods that are not appropriate when applied will cause long completion times and less than optimal results. The working method should produce the product more efficiently. Increase in material prices will lead to an increase in project costs. The cost requirement for the procurement of project materials is more than 50% of the total project cost. Thus, the increase in material prices will cause a very significant increase in project costs. Lack of coordination in the project will have the potential for errors in completion of work, project delays and cooperation between field teams is not well formed. Poor coordination will lead to low control by the management team. Lack of site workers results in the achievement of work progress that is not optimal, so that it ends up in the project experiencing delays. Disputes with subcontractors occur because of lack of detail and lack of clarity in the work contract agreed upon, which creates an ambiguous understanding. A dispute with a subcontractor will result in the subcontractor stopping his work so that the dispute is resolved. The impact is that the progress of the project work will be delayed. This shows that 92.3% of all the risk factors assessed have a serious impact on the success of the project. The results of this study also strengthen the conclusions of previous studies which reveal that a housing development project is a project with a high level of uncertainty and risk. So that risk management in implementing construction projects is absolutely necessary. Risk management that is included in the high category is also treated as for risk factors that are included in the very high risk category. There are two risk factors that have a risk level in the medium category, namely natural disasters and utility and materials delay. The potential for losses caused by natural disasters is indeed high (L = 4.23), the scale of the major impact is, but the probability of natural disasters is still on a low scale or between the rare to the unlikely scale. The utility and material delay factor has a probability that is likely to be on an unlikely scale and the risk impact is close to a moderate scale. Risk management in the medium category involves monitoring or certain responsive procedures.

CONCLUSION

In this study, it is known that 92.3% of the risk factors studied fall into the very high risk and high risk category. This research proves previous studies that the construction industry is highly risk-prone, with a complex and dynamic project environment that creates an atmosphere of uncertainty and high risk. Many risk factors have the potential to hinder the achievement of project objectives, demanding that risk management in housing projects is absolutely necessary. In housing project development, stake holders need to really take into account the price of the land to be developed. Because the high land price determines the total cost of the project and when wrong in making this decision it will result in high project costs. Competition in the housing business and mismanagement of cash flow are also factors that have the potential to disrupt the achievement of the objectives of housing projects in Semarang. Developers need to really consider their project management, risk management and financial management capabilities when competing in a housing development business competition.

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