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COST OVERRUNS ON RAILWAY SIGNALLING PROJECT: QUALITATIVE CASE STUDY ON LRS COMPANY

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Abstract

Railway is a mode of transportation that provides several advantages over other modes in terms of punctuality, capacity and energy efficiency. It is necessary to conduct research to determine the causes of cost overruns, as the basis for the improvement process of Project Cost Management. The research was conducted using a qualitative case study method referring to the Miles & Huberman interactive model, with descriptive analysis. Data collection was carried out by triangulation including in-depth interviews, documentation, and FGDs. The study found that the four factors most frequently mentioned by informants as the main causes of cost overruns, namely: Changes in scope; Extension of time; Weak of internal planning and Increase in material prices.

Keywords: cost overrun; project; railways; signalling; company; transportation

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INTRODUCTION

The government continues to develop rail transportation modes to support the mobility of passengers and goods. Several advantages of railway transport mode including large capacity; low operation cost; punctuality; and environmentally friendly (electric train). As with other modes of transportation (land, sea and air), rail transportation has four main elements, namely ways elements in the form of rails or guide ways, vehicles elements in the form of trains, terminal elements represented by stations and shelters, and controller elements including a signalling system. As Mandated by Law No. 23 Year 2007, the Indonesian Government developed a railway infrastructure system, including signalling system, which was funded by the State Budget (APBN), or using Public-Private Partnership (PPP) scheme.

The railway signalling system plays an important role to ensure the safety of train travel. The modern electronics system with higher level of safety and providing more line capacity at that time was still dependent on very expensive foreign technology. The government was trying to develope local signalling capabilities which was realized by assigning one of state-owned company, PT. Len Industri (Len), to act as an agent of Transfer of Technology (ToT), and has been involved in modern signalling construction project since 1980s. Two decades later in 2002, Len has produced their own signalling system and has become the backbone of the development of the national railway transportation system to date.

In order to focus on the railway business, in 2012 Len carried out a spin off of their railway business unit to become a subsidiary, namely PT. Len Railway Systems (LRS). To date, LRS has carried out many railway signalling system projects. But unfortunately, there are still some projects that have experienced cost overruns. As a consequence, this situation reduces the profitability of the project, which in turn threatens the achievement of the company's goals. In addition, this condition can also interfere with the achievement of the objectives of the government's railway development program. In general, the problem of cost overruns in railway construction has been found in the research of Andric et. al. (2019), which examined more than 100

major infrastructure projects in Asia between 1987-2011. The results of the study found that the average cost overrun for railway projects in Asia was 21.11%. To overcome this problem, serious efforts are needed to be done by management, as an agent of the principal. One of the steps that must be done is to improve Project Management system, in particular Project Cost Management. Improving the Project Cost Management System must begin with an in-depth study of causes of the project cost overruns that have occurred so far. The results of the study will become the basic step for the design phase of the new Project Cost Management concept, in accordance with international best practices that will be implemented.

According to the neo-classical view of economics, the purpose of establishing a company is to maximize profit. Whereas in one modern view there is a shift towards increasing the value of the firm (Sugeng, 2019). In large-scale companies, a separation is made between the owner and the manager (Asnawi, 2017). The owner of the company will appoint another party as a representative/agent (agent). The interests of the owner of the company (principal) through increasing profits and company value are the highest priority for agents. The relationship between the agent and the principal above is known as an agency relationship. This agency relationship is defined as a contract between one or more people, who act as the principal, with another person as an agent, then the agent accepts the delegation of authority for decision making and performs some services on behalf of the principal (Jensen & Meckling, 1976). The contractual relationship between the principal and the agent is part of a "set of contracts among all factors of production", which is also one of point of view at an economic organization (Fama, 1980). Measuring performance and measuring appropriate rewards are two things that are the main requirement in an economic organization (Alchian & Demsetz, 1972). The agent is bound by the principal through a series of KPIs that must be achieved. The achievement higher than the KPIs (favorable deviation) will provide rewards. While the achievement below the KPI (unfavorable deviation) without acceptable justification will result in punishment. Unexpected achievement of agent performance or below the KPI can ultimately result in a reduction in the welfare of the principal. This reduction in welfare is categorized into residual loss. Meanwhile, efforts to avoid this through additional monitoring by the board of commissioners and an additional audit committee will result in additional costs, which are categorized as monitoring costs (monitoring expenditures by the principal). Residual loss and monitoring costs are part of agency costs (Jensen & Meckling, 1976).

LRS is a subsidiary of a state-owned company whose shares are one hundred percent owned by the state. Len acts as the principal, while LRS Management is an agent who gets delegation from the principal to manage the company. Len's interests as the owner of the LRS, and furthermore the state as the owner of Len, must be highly prioritized by LRS Management. This interest is not only related to the state as the principal, but also to the state as the owner of most of the railway signalling projects undertaken by LRS (the majority of projects undertaken by LRS are funded by the state budget or APBN). The form of responsibility of LRS Management to principals is to generate maximum profit according to the established KPI. The resulting profit will be returned in the form of dividends as state income, as well as an increase in the value of the company. Meanwhile, responsibility LRS to the state as the owner of the railway signalling project is the achiement of all project requirements.

To ensure the achievement of the company's goals, LRS Management needs to implement good and suitable corporate management practices, especially in the field of Project Management. The implementation of good Project Management is one of the main duties and authorities delegated by the principal to the LRS Management as the agent. Vasista (2017) in his research reveals the importance of measuring costs according to the terms of the agreement in the contract as an objective measure in assessing project success. Improving the project management process is one of the factors that significantly and positively improves project financial performance and the level of company competitiveness (Huda et al. 2018). One of the references in Project Management practices is PMBOK (Project Management Body of Knowledge) published by PMI (Project Management Institute), the first organization for Project Management experts and practitioners from around the world. PMBOK is a summary of Project Management best practices formulated by experts from many different field of projects around the world. The method in PMBOK is explained in more detail and developed from the 1st edition to the 6th edition. Meanwhile, the 7th edition provide more on the principle aspects that underlie all existing practical methods. In PMBOK 6th edition, the definition of a project is "A temporary endeavor undertaken to create a unique product, service or result." (PMI, 2017). While Project Management is defined as "The application of knowledge, skills, tools and techniques for project activities in achieving of project requirements." (PMI, 2017). Project Cost Management is one of the 10 knowledge areas in the 6th edition of the PMBOK guidelines. This guideline can be used as a reference in improving Project Cost Management at LRS to reduce the risk of cost overruns. The implementation of best practices in the PMBOK will be the main focus on improvement of Project Cost Management in the LRS. And prior to the new Project Cost Management design is carried out, it is necessary to study the current problems, as well as collect the ideas related to the concept of implementing the PMBOK. From a series of research to improve Project Cost Management in LRS, the focus of this article is only on the part related to extracting information on the problems of current and previous Project Management practice.

The novelty in this research lies in the object of the railway signalling construction project which is a very specific field, not only in Indonesia, but also globally. In addition to specific fields, the novelty also lies in qualitative research methods with data collection instruments that apply method triangulation and source triangulation (Satori & Komariah, 2020). Specific references that match the focus and object of the research carried out are still difficult to find.

METHOD

The method used in this research is a case study qualitative method, which uses descriptive analysis (Sugiyono 2017). Specifically, this qualitative research will use the interactive model of Miles and Huberman as described in Figure 1. The process flow of research conducted to explore information about current Project Management practices, common problems and problems related to cost overruns, as well as ideas for improving Project Management. The use of this qualitative method is based on the need to deepen the meaning of the problem of project cost overruns, as the basis for a more precise improvement plan. In addition, there is the availability of a sufficient number of informants, who have criteria for experience in involvement in railway signalling projects, and have sufficient knowledge of Project Management based on PMBOK 6th edition.

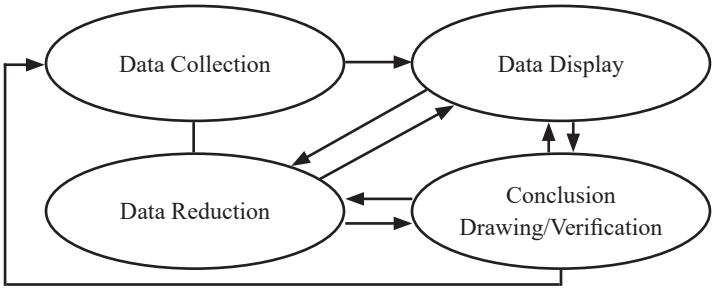

Figure 1. Miles and Huberman's Interactive Model

The informations gathered from the interviews are the primary data. Its have been verified by FGDs process and strengthened by secondary data in the form of documents related to the project SOPs of LRS. Data collection is the first activity in Miles and Huberman's qualitative research model. Sugiyono (2017) is stated that there are at least four kinds of data collection techniques in qualitative research, namely observation, interviews, documentation and triangulation or a combination. In this study, data collection techniques were carried out through In-depth interviews; Documentations; Observations and FGDs. The combination of these three techniques is categorized as a triangulation technique, while the diversity of sources in the interview and FGD stages can be categorized as source triangulation (Satori and Komariah 2020). The technique of determining the sample of informants in the interview stage uses a combination of purposive sampling and snowball sampling (Sugiyono, 2017). The number of informants who participated in the interview grew to 21 people, and the FGDs stage was attended by 50 people. The growth of the number of informants is a consequence of the choice of snowball sampling technique. List of functional backgrounds and positions of the informants can be seen in Table 1. Meanwhile, if we mapped in the LRS organizational structure, the distribution of informants as shown in Figure 3 has covered all divisions in the company.

Table 1. List of Informants of In-depth Interview

No	Organization Units/Function	Code	Number
1	Quality Systems Function	MS01	1
2	Corporate Planning and Evalution Department (MSO)	CP01	1
3	Finance Department	FI01	1
4	Project Manager	PM01-PM09	9
5	Procurement Department	PR01	1
6	Engineering Division	EN01	1
7	Project Management Experts	EX01-EX02	2
8	Sales Department	SL01	1
9	Risk Management Function	RM01	1
10	Project Management Department (PMD)	PC01	1
11	Accounting Department	AK01	1
12	Human Capital Department	HC01	1
	Number of informants		21

One of the important things in qualitative research is the validity of the data and the level of trustworthiness of the research. The criteria related to the level of trust are credibility, transferability, dependability and confirmability. Some of the techniques used to increase confidence can be seen in Table 2.

Table 2. Trust-Improving Techniques

Criteria Area	Technique
Credibility	1. Activities that can increase probability and high credibility
	2. Peer interview
	3. Negative case analysis
	4. Referential adequacy
	5. Member checking
Transferability	6. Bold description
Dependability	7a. Dependability check including check trace
Confirmability	7b. Confirmability check including check trace
Everything above	8. Reflective amount

Source: Research Trust Improvement Techniques (Ghony, Wahyuni and Almanshur 2020)

RESULTS

From the transcription of the recorded in-depth interviews, data reduction was carried out by exploring the substances. Prior to data reduction, a transcription reconstruction was carried out so that the substance conveyed by the informants could be seen on the surface more clearly. Furthermore, the transcript of the reconstruction results is given a reflection note in the form of reflection on substance, reflection on methodology and reflection of analysis (Satori and Komariah 2020). Substances that emerge from each informant will be labeled according to their category. The two main categories are perceptions related to current Project Management practices, as well as input ideas related to Project Management improvements in the future. The perception category groups related to Project Management practices caught by the informants were divided into three, namely positive perceptions, neutral perceptions and negative perceptions. Meanwhile, the group of substance categories related to the idea of improving Project Management is divided into two, namely improving Project Management in general, and ideas for improving Project Cost Management which refers to the 6th edition of PMBOK. Substances are labeled according to their category and order. Category 1-3 code labels are perceptions of current Project Management practices, while 4 and 5 are ideas for improving the Project Management system. The order of substances in a category is represented by the alphabet added to the category label code. The details of the substance label code according to the category are: Positive Perception (POS) i.e. [1+Alphabet]; Neutral Perception (NET) i.e. [2+Alphabet]; Negative Perception (NEG) i.e. [3+Alphabet]; The Idea for Project Management Improvement (MNP) i.e. [4+Alphabet]; The idea of Implementing PMBOK (PBK) i.e. [5+Alphabet].

Table 3. Number of Substances by Category

Category Labels	Substance Category	Number of Substances
1	Positive Perception (POS)	40 (1A – 1AN)
2	Neutral Perception (NET)	32 (2A – 2AF)
3	Negative Perception (NEG)	53 (3A – 3BB)
4	The Idea of PM Improvement (MNP)	51 (4A – 4AY)
5	The Idea of PMBOK Implementation (PBK)	78 (5A – 5BZ)

DISCUSSION

Five processes in the project according to the PMBOK 6th edition, namely initiating; planning; executing; monitoring and controlling; closing (PMI 2017). In this study, the discussion of the results of data collection (Conclusion Drawing/Verification) in accordance with the Miles and Huberman research model, will use the the 6th edition of PMBOK as the reference. According to Ahiaga-Dagbui et. al (2017), the cause of cost overruns can only be understood by looking at the entire project system where the overruns occur, and how some of these variables thought to cause it interact dynamically with each other.

Figure 2. Process Sequence in the Project

The flow of project handling at LRS, begins with the determination of the annual business plan. This plan is stated in the KPI in the form of project targets that must be won and the expected level of profitability. The target of the KPI affects decision making in the review of order process. The review is carried out after the tender announcement is made, to determine whether or not to participate in the tender. The Tender Team will calculate the initial Project Budget Plan (RAP) and assess the risks of the project opportunities. These two things will form the basis for management decision making. In the substance of the interview with label [2I], informant SL01 said that when faced with a project that has a high level of competition, the option of winning the tender becomes a top priority compared to the profitability target. In other words, the price competitiveness strategy is an option for projects with intense competition. This choice had to be taken considering that the number of signalling projects per year could be counted on the fingers, while the company's fixed costs were quite high. This high fixed cost is because signalling competence is a rare field and requires high competence and qualifications of engineers, as well as special equipment with high investment value. So it is not surprising that not only in Indonesia, even in the world there are very few companies like LRS.

This tight competition can occur because although high competence is required and must be proved, the tender requirements are easier to be achieved and factual verification of these competency requirements is not required. When the tender lead to price competition, RAP calculations tend to override the detailed items and the potential risks during the execution process. Ignoring risk factors to pursue competitive prices is certainly a condition that will have the potential to increase costs and reducing the level of project profitability. When it is decided that the tender will be followed, the Tender Team will prepare all required documents including technical proposals and work methods, price proposals, and other administrative requirements documents. The composition of the RAP, which forms the basis for calculating the RAB, contains components of the real project costs as an element of the Cost of Production (HPP), operating expenses, and other expenses. When the company is declared to have won the tender and received a contract, all documents that will be used as a reference for project implementation will be submitted by the Tender Team to the Project Team as the basis for the planning process.

Several substances regarding the causes of project cost overruns that were related to activities at the planning stage including: (1) Improper internal company planning [3H]; (2) Supporting materials are not taken into account in the RAP [3W]; (3) Prior to 2021 the real cost of HSE is not included in the budget [3AJ]; (4) Over-calculation of the quantity of materials [3AV].

When referring to PMBOK, the substance above is related to problems in the Project Scope Management knowledge area. At least numbers 2, 3 and 4 show that there are some details that contain elements of costs have not been included in the initial work planning. In the project management practice of signalling construction at the LRS, the initial stage carried out by the Project Team is the finalization of the Project Budget Plan (RAP) which was previously transferred from the Tender Team. The basis for this finalization is the initial RAP, and the technical review and survey conducted by the Project Team, with the assistance of the Engineering Team. From the initial survey by, information was obtained to verify the initial RAP so that it can be finalized, including the calculation of the HPP, which will be the basis for determining the target of maximum budget to be achieved by the Project Team.

After determining the budget, determining the Project Team, and determining the profitability target represented by the amount of HPP, one stage before execution is the opening of the project code. This stage is still part of the planning process because there are several document requirements that must be made and submitted by the Project Team. The process of unlocking this project budget has been standardized in the FOP-01 procedure. The documents that are required for the opening of the project code are used as references in the supervision and control process during the project execution, including the cash flow plan. Informant MS01 said that in some projects the cash flow plan had not been prepared properly, due to the lack of knowledge of the Project Team [3AG]. This poor cash flow planning can be one part of inaccurate internal planning that causes project cost overruns.

In the previous research, problems related to planning were presented in Susanti and Nurdiana (2019) regarding inaccurate budgeting. In PMBOK 6th edition, element of cost budgeting is one of the individual processes of Project Cost Management knowledge area, that is related to the planning process. Yismalet & Patel (2018), in their research, found that accurate cost estimates from the tender stage and budgeting as well as monitoring and control at the construction stage, will affect the project's financial performance. Another problem regarding individual

processes cost estimation is disclosed in Durdyev et al. (2017), and Idan and Dheyab (2019). The problems in LRS, although they seem different, are related. In PMBOK the individual process of budget planning requires input of scope of work represented by the Work Breakdown Structure (WBS), estimated costs and schedules. Inaccuracies in determining the detailed scope certainly result in inaccurate budget plans which have the potential to cause cost overruns. Poor cash flow planning can be caused by weak cash flow planning competence of the Project Manager. Related to this, research conducted by Dlamini & Cumberlege (2021) found that cash flow management is one of the key competencies to avoid project cost overruns.

One of the main activities in the execution process is the project procurement of materials and services. This process is started with selection of materials, suppliers and subcontractors. This selection activity is an important stage in the project execution process that will significantly affect project costs. Although the price element is very important, the price factor will be the next consideration after the specifications, quality and delivery schedule can be met. From the substance of the interview with informant PR01 with the label [2Q], it is known that the main signalling material is procured from abroad with a long delivery time. As a solution to save time, LRS will carry out a stock program for the main material half of the projected in the current year demand forecast [1V]. Most of other materials can be procured domestically, this will be done after the release of Bill of Quantity (BoQ) from the engineer refers to the final RAP. The informant EN01 said that in the BoQ, the engineer will include more than one product that meets the specifications and quality requirements if possible [1O]. Later on, the Project and Logistics Team will be able to select the product according to the price and payment criteria. The reference information in the RAP will include price information that refers to the Logistic Estimated Price (HPS). In the substance presented by informant PR01, the database of HPS will be updated once in 6 months for materials [1W] and once a year for sub-contracted work items [1X].

One of the problems that appeared at the execution stage that caused the cost oveeruns were the increase in the price of the material [3O]. For imported materials, one of the reasons could be the increase in foreign exchange rates [3AS]. The price increase factor was also mentioned in previous research by Idan and Dheyab (2019) and Susanti and Nurdiana (2019). Pratiwi (2012) in his research found that material price fluctuations have a negative effect on the efficiency of project cost performance. Meanwhile, Khanal and Ojha (2020) alluded to inflation which will affect prices. For sub-contracted work items, rising costs can be caused by several factors, both related to rising prices of supporting materials, less accurate planning and limited knowledge and experience to find solutions for more efficient work methods [3AR]. In addition to the problem of the realization price being higher than planned, several other problems that could cause cost overruns in the execution process including: (1) Changes in the scope of work [3C]; (2) Added duration of work [3R]; (3) Location not ready [3Q].

The change in scope that are not proportional to changes in the budget was the factor causing cost overruns that were agreed by the majority of informants. This is further due to the government rules regarding the maximum limit for additional budget for state budget (APBN) projects. If the additional requirement exceeds the maximum limit for the additional budget, then the additional item must still be accommodated with the additional costs be absorbed as contractor's risk. This condition will certainly increase costs and reduce profitability. In previous studies, changes ordered by the project owner became the factor that was most often found as the cause of project costs overruns. Shrivastara et al. (2019) categorizes it as a customer-related risk, in line with Kim et al. (2015) which categorizes as a factor owner. This factor was also mentioned in the research conducted by Susanti and Nurdiana (2019). Abusafiya and Suliman (2017) specifically mention frequent design changes as a major factor.

The signalling construction work package is usually not a stand-alone package but will be related to other work packages. There are work items that can be done in parallel with other work, while some have to wait for the completion of other work packages as a predecessor work. The risk of delay will occur if the predecessor package is delayed. This was also mentioned in a previous study by Susanti and Nurdiana (2019) as a factor in location conditions. As a consequence, an acceleration (crash program) is needed which of course requires additional costs. Meanwhile, on the other hand, the additional costs for the acceleration, cannot be accommodated in variation order for state budget (APBN) project.

The fourth process in PMBOK is monitoring and controlling. In the context of the practice of Project Management at LRS, cost monitoring and control is carried out continuously with the execution process. Each submission of a material procurement or sub-contract work service will be verified against the available project budget according to the type of cost code. If the material budget item is still available in the same amount or exceeds the material procurement submission requirement, then the submission will be approved. This also applies to the sub-contract budget items for submission of work services. If the remaining budget that is still available is insufficient, then a budget review will be carried out to determine the follow-up steps. The steps taken can be in the form of increasing the budget (ABT), shifting between budget items (cost code), or other steps including finding alternative product solutions.

The budget review step is also carried out on changes to the scope of work and the extension of the contract period requested by the project owner. Even though a verification has been carried out on the remaining budget prior to the procurement submission, the information is only carried out on the remaining budget without further verification of the requested items related to material list in RAP. It is known that the aggregate of the details of the RAP is the basis for calculating the value of each budget item, which is also a reference in monitoring and controlling project costs. Although the remaining budget in a budget item is still sufficient to accommodate a proposal, if the proposed item is not included in the RAP, there will be a latent potential for cost overruns in the future. The informant MS01 said that before 2021 there had never been a special item related to HSE spending in the RAP [3AJ], even though in real terms there were expenditures. Another example is the existence of items that are supporting materials that are not included in the RAP, but are still executed as long as there is still a budget remaining at the time the purchase of the material is submitted.

According to informant MS01, current cost control does not pay attention to the remaining budget for the remaining needs. Data related to how much is needed to complete the project or in PMBOK known as ETC (Estimate to Completion) is not yet available in a system, so that the submission of shifts or requests for additional budgets can occur several times during the project. Data related to budget absorption, which is still recorded manually in several separate work units [3BA], can also lead to misinformation which can lead to wrong decision making in the context of cost control.

In addition to monitoring the cost budget, monitoring of cash flow realization is also not optimal when cash flow plans are not made with high accuracy. Missing cash inflows from the project resulted in late payments to suppliers and sub-contractors. Late payments to suppliers and sub-contractors can result in delays in procurement, which in the end will delay project progress and further result in additional delays in cash inflows. The situation will roll like a snowball and threaten the completion of the project itself. This is in line with research conducted by Niazi and Painting (2017) which found late payments as one of the factors causing project cost overruns.

In the last process, namely the closing of the project. In accordance with the applicable SOP, the closing of the project code must be followed up by transferring the after-sales budget to other budget items in accounting, checking the completeness of the final deliverables, and evaluating project performance. At the closing, the risk monitoring document on the project should also be closed. Although it is stated in the SOP, in practice before 2020 project closing reviews are rarely carried out. So it is possible that a risk will continue to occur repeatedly in the next project, including risks related to cost overruns. Informant RM01 said that the lessons learned on the realization of risks in the previous project have become a reference for the next project. It's just that for APBN projects with standard and rigid rules, it is very difficult to change the contract agreement so that it has the potential to repeat the previous risk [3AO]. The risk planning carried out since the initiation phase should also be improved. The risks in each project will be unique, and not all risks can be identified. For this reason, Kwon & Kang (2019) in their research suggest the existence of reserve management that must be estimated and included in the project budget to anticipate this, so that its realization does not cause cost overruns. Even though the project budget has been closed, there is still a risk at the project maintenance stage when the after-sales budget allocated is insufficient, caused by error in after-sales planning, as well as major damage beyond the control of the After-sales Team.

CONCLUSIONS

Project Management Practices carried out by LRS have followed the SOPs set by the company, although improvements and additional procedures are needed to complement the existing SOPs. There are still cost overruns in several railway signalling system construction projects carried out by LRS. From the substance of in-depth interviews with informants and were verified by FGDs, it was found that project cost overrun is a very complex problem and is caused by so many factors. At least 45 factors that were stated explicitly or implicitly by the informants as the causes of project cost overruns. The problems were occurred in all process of the project regarding PMBOK 6th edition including initiating; planning; executing; monitoring & controlling; and closing phases. The four causes of cost overruns that were most frequently mentioned by the informants in sequence are: changes in the scope of work; increase of the duration of the work; weak of planning; and increase in material prices. Further quantitave research should be conducted to find level of significancy among all factors on how they could influence the cost overruns problem. That information could be useful for the company in prioritizing which problem to be resolved first.

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