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Risk Assessment of Productivity Recovery Post Occupational Accident in Indonesia

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ABSTRACT

Indonesia's public health provider, the Insurance Administration Organization (IAO), provides universal coverage for Work Accident Insurance. As an initiative, it has failed to support all workers. This study assesses productivity recovery risks and associated future costs following occupational accidents, employing risk management methods and scenario analyses to aid decision-making in Indonesia. Focusing on formal workers in Surabaya, this research examines the balance between government benefits and expected productivity rebound upon return. Six risk types are identified and analysed, while the most prevalent risks involve workers still undergoing treatment with uncertain outcomes. As existing coverage schemes risk negative cash flow and deficits, this study also calculates the budget needed for zero-accident targets and maximum compensation to balance government obligations and workers' remuneration. This research highlights key elements for enhancing coverage and tackling financial shortfalls, while utilizing a risk matrix and Monte Carlo simulation grounded in NPV to evaluate the long-term viability of Work Accident Insurance (JKK). Integrating financial and social aspects provides an innovative view to enhance employee recovery and productivity within the Indonesian framework.

Kata Kunci : *Risk management, Occupational accident, Feasibility analysis.*

A. INTRODUCTION

Work-related accidents, or occupational accidents, are a global concern impacting the well-being of the productive working-age population. The impacts of these accidents, though challenging to measure, reverberate throughout society, causing financial strain from the government to the workforce due to lost productivity (Melchior & Zanini, 2019). While it is widely acknowledged that work accidents cause challenges for multiple parties, pinpointing their exact impact or learning from them has proven difficult due to reluctance to accept responsibility (Niza et al., 2008). However, it is understood that work accidents can diminish productivity. In previous studies, it has been shown that many companies do not adhere to ergonomic principles to mitigate associated costs, thus increasing the prevalence of injuries and exacerbating them (Shikdar & Sawaqed, 2003). The notion that many companies are negligent and possibly indifferent to work accidents experienced by workers has been previously identified. Additionally, it is discovered that work accidents lead to a decline in worker performance, which influences decreased productivity and slower and weaker job performances (Katsuro et al. 2010).

Productivity, traditionally defined as the ratio of output to input, is considered a crucial factor in industry competitiveness and economic production activities (Parmar, 2003). Additional definitions of productivity are described for further clarification. Productivity, as mentioned by the OECD, is defined as the ratio of output measured to input (OECD, 2001). Disability-adjusted life years (DALYs) are incorporated into productivity research to assess lifetime productivity lost due to accidents. DALYs are defined as the sum of the present value of future years of life lost due to premature death and the present value of future years of life lost due to mental or physical disability due to injury (Fox-Rushby & Hanson, 2001). Productivity-adjusted life years (PALY) complement DALYs by addressing limitations in conventional productivity measurement, particularly in accounting for long-term productivity loss at the population level (Ademi et al., 2021).

TABLE 1
Workplace Accident Trend and the Impact from the Year 2001 to 2010

Year	Workplace Accidents	Deaths	Full Disability	Partial Disability	Functional Disabilities	Recuperated
2001	104,774	1,768	280	4,923	7,363	90,440
2002	103,804	1,903	393	3,020	6,932	97,556
2003	105,846	1,748	98	3,167	7,130	93,703
2004	95,418	1,736	60	2,932	6,114	84,576
2005	99,023	2,045	80	3,032	5,391	88,475
2006	95,624	1,784	122	2,918	4,973	85,827
2007	83,714	1,883	57	2,400	4,049	75,325
2008	93,823	2,124	44	2,547	4,018	85,090
2009	96,314	2,144	42	2,713	4,380	87,035
2010	86,693	1,965	31	2,313	3,662	78,722

Understanding the composition of Indonesia's labor force is essential for examining workplace events, given that the National Statistical Bureau categorizes workers into formal and informal sectors. As per the ICLS, the informal sector comprises small, privately-held non-corporate enterprises that usually bypass labor laws, taxation, and social safeguards (Hussmanns, 2004; ICLS, 1993). Most Indonesian workers are in this sector, which encounters increased accident risks, especially in construction (Madya & Nurwahyuni, 2019). In Indonesia, rates of occupational accidents continue to be consistently elevated and vary over time; however, the data presented in Table 1 pertains solely to employees in the formal sector. Events related to informal workers are mostly untracked and probably underreported (Darisman, 2011), resulting in this at-risk population lacking sufficient representation in official data. Numerous informal workers are also unaware of government insurance programs (Adlilah et al., 2019), and despite the Insurance Administration Organization (IAO) attempting to broaden health coverage across the country, the difficulty of affording premiums continues for informal workers and their employers (BPJS Ketenagakerjaan, 2018).

The current situation in Surabaya underscores the significant challenge in monitoring post-occupational injury cases, primarily because of the lack of a cohesive data recording system and the participation of various Regional Apparatus Organizations (RAOs) in addressing different facets of case management, as shown in Figure 1. Although each RAO, including the Department of Manpower, the Social Security Administrator, and the Department of Public Health, possesses pertinent datasets, these are fragmented, incomplete, and not longitudinal, hindering the capacity to track workers' recovery progress and assess the lasting effects of occupational accidents. At the national level, the government aims to achieve universal coverage via the National Health Insurance (NHI) under the IAO, with the IAO Employment (IAOE) particularly managing the Work Accident Insurance (JKK) to tackle workplace dangers. Rehabilitation services, such as physiotherapy, occupational therapy, speech therapy, and prosthetics, are offered by hospitals, health centers, community clinics, and private practitioners; nonetheless, gaps in service continue due to inadequate resources and a lack of trained professionals (Simeu & Mitra, 2019). These systemic constraints are intensified by the reality that the reintegration of rehabilitated workers with disabilities is still low, as numerous companies find it difficult to meet their requirements, thus worsening return-to-work obstacles and diminishing the overall effectiveness of the protection scheme.

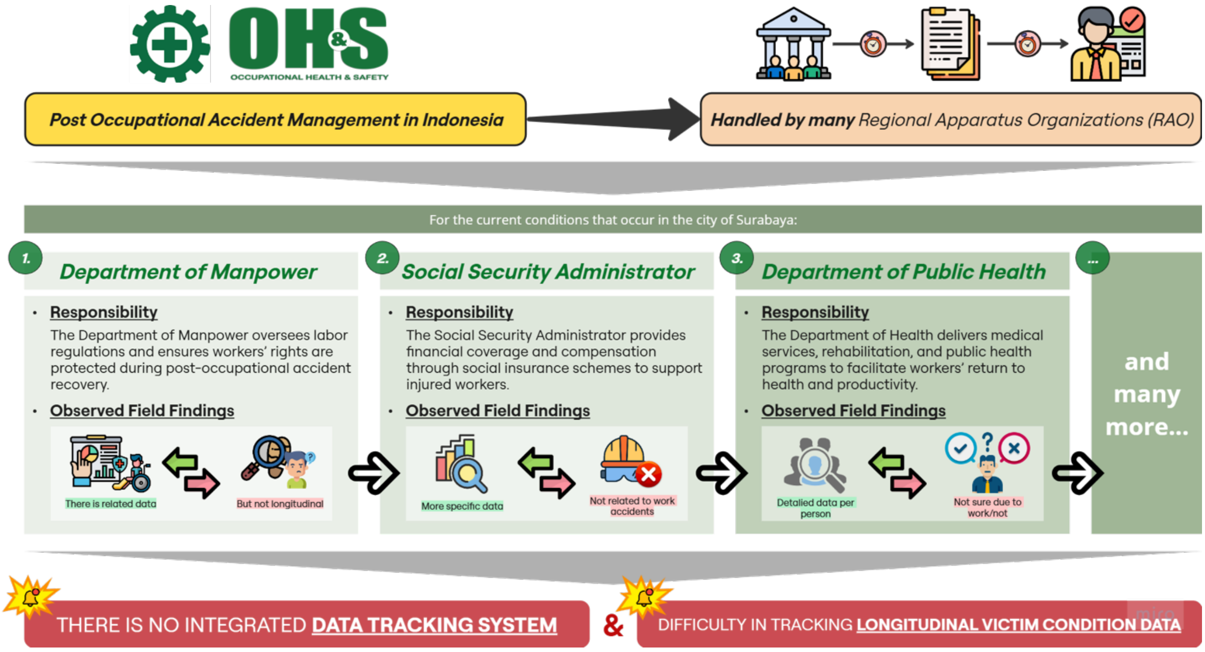

Figure 1. Visualization of Occupational Accident Data Challenges in a Rich Picture Diagram

Post-accident rehabilitation relies heavily on return-to-work programs, but their effectiveness is still under scrutiny (Bae et al., 2019). The existing IAOE program offers medical care, rehabilitation, and job training; however, problems remain: interviews conducted in Jakarta indicated a preference for private healthcare over designated facilities, worries about insufficient medication, decreasing rates of returning to work, and diminished economic stability post-accident. These issues emphasize the necessity to evaluate if compensation sufficiently returns workers to their previous standard of living. Considering Indonesia's intricate circumstances, this research concentrates on Surabaya to analyze the effects of accidents on the working-age demographic and to examine return-to-work initiatives from both public and private insurance viewpoints. In contrast to earlier studies that mainly provided descriptions (Katsuro et al., 2010; Madya & Nurwahyuni, 2019), this research combines a risk matrix with Monte Carlo simulation employing NPV to evaluate the long-term viability of Work Accident Insurance (JKK), providing groundbreaking insights that can assist stakeholders in developing better strategies for employee recovery and productivity.

B. BACKGROUND INFORMATION

This section describes the methodical procedures used in the study to assess the efficacy of return-to-work programs and analyze the effects of workplace accidents. It is organized into two primary stages, starting with an explanation of the basic ideas and theoretical models that support the study. The methodological approach, which explains how these ideas are operationalized into useful tools and analysis techniques, is presented in the second phase.

1. Fundamental concepts and theories

Workplace or occupational incidents are characterized as unexpected occurrences associated with employment that result in physical or psychological harm (Nowacki, 2021; BLS, 2016). Worldwide, the International Labour Organization (ILO) estimates that over 2.78 million workers perish annually from work-related accidents or diseases, while an additional 374 million suffer non-fatal injuries. If left unaddressed, these occurrences could potentially result in losses of up to 4% of the global annual GDP (ILO, 2020). The impact is significantly greater in developing nations, where rates of fatal workplace incidents are three to four times greater than in developed countries. In certain regions of Africa, for instance, the unveiling of new instruments and substances alongside hazardous working conditions has heightened the incidence of accidents.

The construction industry is continually recognized as the sector with the greatest accident frequency relative to manufacturing, mainly because of its dependence on outdoor work and exposure to environmental elements like temperature, humidity, and wind (Kang & Lyu, 2019). This complexity renders the execution of Occupational Health and Safety (OHS) management especially difficult, despite continuous preventive measures (Lee et al., 2020). Conversely, sectors that primarily function indoors are not as impacted by these external influences. In Indonesia, the condition continues to be severe, as a combined report from WHO and ILO designates the nation as a red zone, indicating an estimated 43.8–79.5 fatalities per 100,000 working-age individuals associated with 41 related occupational risk factors as ilustrated in Figure 2 (WHO & ILO, 2016).

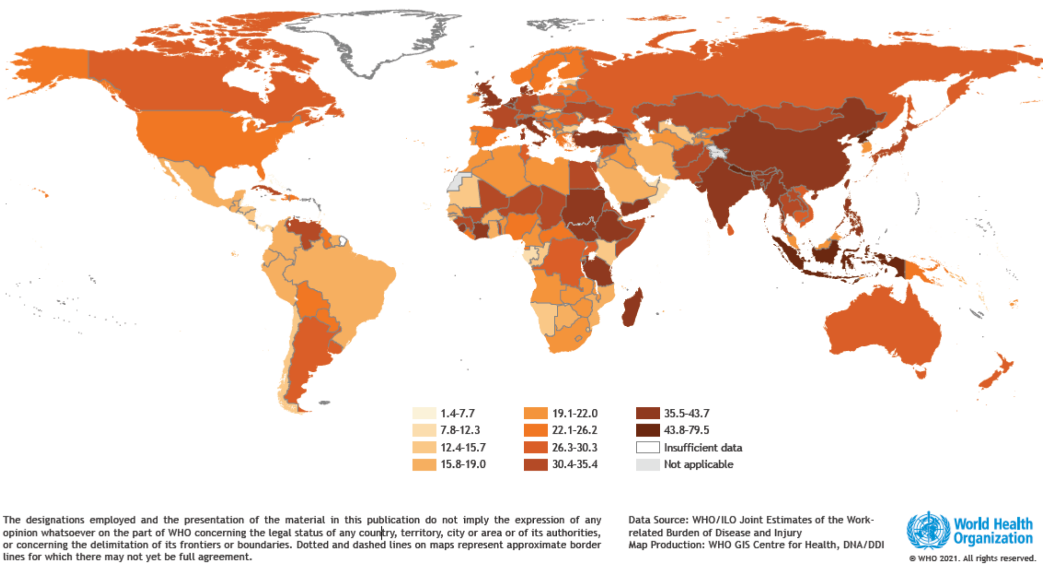

Figure 2. Rate of Total Deaths (Number of Deaths Per 100 000 Working-Age Population) Attributable to the 41 Pairs of Occupational Risk Factor and Health Outcome, 2016

In Indonesia, workplace accidents are legally characterized in Minister of Manpower Regulation No. 3 of 1998 as unexpected occurrences that can result in loss of life or property, with Chapter 2 Article 2 outlining major categories including fires, explosions, waste-related risks, and other hazardous events. Employers must record every accident and register employees in the national health insurance program. Regardless of regulatory initiatives, accident rates continue to be elevated, with the construction industry as the main contributor, and while figures have decreased, Indonesia still reports some of the highest accident rates in Southeast Asia (Swaputri, 2013). The Minister of Manpower and Transmigration Regulation No. 9 of 2005 provides additional classification of accident types, as detailed in Table 2.

TABLE 2
Workplace Accident Category and Code

Code	Details
A	Impact with object resulting a scratch, cut, impaled, etc.
B	Trauma due to fall
C	Trapped between two objects include drowned, bitten, and pinched
D	Tripping
E	Falling
F	Slipping
G	Exposed to conditions such as vibration, air pressure, lightning, etc.
H	Inhalation of harmful substances or the absorption of substances through the skin
I	Electrocuted
J	Others

a. Coverage and Plans

The Ministry of Health has been working on an extensive national healthcare system, highlighted by the initiation of the Healthy Indonesia Program in 2015 to enhance service quality through changes in approach, reinforced primary care, and national health insurance (JKN). Administered by the Insurance Administration Organization (IAO), JKN offers outpatient and inpatient coverage across all hospital tiers, although some treatments may be partially or not covered at all. In addition to this, IAO Employment (IAOE) provides four service lines—JKK, JHT, JP, and JK—with key details outlined in Table 3.

TABLE 3
Insurance and Security Payment Composition and Details

Program	Premium	Details
JHT	5.7% from monthly salary	2% is from the worker while 3.7% is deducted from salary from employer

JKK	very low risk = 0.24% of the monthly salary;
	low risk = 0.54% from the monthly salary;
	moderate risk = 0.89% monthly salary;
	high risk = 1.27% of monthly salary;
	extreme risk = 1.76% of monthly salary
		Paid by employers, deducted from the monthly salary

JP	3% from monthly salary	1% paid from the employee while 2% paid from the employer
JK	salary worker = 0.3% of monthly salary	salary worker = paid by employer

informal worker = IDR 6,800	informal worker = paid individually

The Indonesian Accident and Occupational Employment (IAOE) program offers vital services, such as medical care, family support in the event of death, and retirement pensions (Pereira & Monteiro, 2019). An essential element is the return-to-work initiative, which assists individuals whose ability to work has diminished because of illness, aging, or disability. This program provides therapy, rehabilitation, and training to ensure seamless reintegration into employment (BPJS, 2018).

b. Disabilities in the Workplace

Integrating individuals with disabilities (PWDs) into the workforce continues to be difficult because of prejudices, a lack of job openings, and inadequate support. Employers frequently view greater risks in employing PWDs, leading to diminished job security and promotional opportunities (Sundar et al., 2018), whereas PWDs encounter obstacles related to disabilities, job structure, and educational limitations that hinder workforce involvement (Frian et al., 2019). Disability definitions vary; the U.S. CDC highlights impairments, limitations in activities, and restrictions on participation, while Indonesia's Law No. 8 of 2016 describes disability as enduring limitations that obstruct the enjoyment of fundamental rights. Data from the Ministry of Health's Basic Health Research are used to determine the prevalence of PWDs in Indonesia, calculated with Equation 1.

$$Proportion\,of\ PWD = \frac{\sum people\,age\,18-59\ with\,disability}{\sum people\,age\,18-59} \qquad (1)$$

c. Net Present Value

Net Present Value (NPV) is a fundamental principle in financial management, evaluating the disparity between current values of cash inflows and outflows to enhance shareholder wealth (Pandey, 2015). Tightly associated with Discounted Cash Flow (DCF), which determines company value based on forecasted profits, NPV stands out by explicitly considering initial investment, rendering it the favored approach for investment assessment (Harman, 2015; Beers, 2021). Analysts usually evaluate elements like operating profit, depreciation, capital, and taxes to calculate free cash flow, with projects usually approved when NPV is positive or inflows surpass outflows (Van Horne & Wachowicz Jr, 2008). The standard NPV formula is presented in Equation 2.

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - C_0 \qquad (2)$$

Where CF_t is cash inflow at time period t, r is discount rate (or required rate of return), n is total number of periods, and C_0 is initial investment (cash outflow at time 0).

d. Scenario Analysis and Sensitivity Analysis

Scenario analysis and sensitivity analysis are commonly used in financial theory as methods to manage uncertainty. Scenario analysis evaluates portfolio or asset values under varying conditions, like shifting security prices or interest rates, and is utilized by corporations and governments to foresee risks—in contexts such as Pentagon defense planning and Shell's global demand predictions (Hayes, 2019; Noone & Ackerman, 2013). Instead of forecasting precise results, it tackles *"what-if"* scenarios to examine worst-case situations and assess possible reactions, thus expanding viewpoints and enhancing sound decision-making (Duinker & Greig, 2007).

Sensitivity analysis enhances this method by measuring how changes in uncertain inputs influence model outcomes, enriching the comprehension of variable interrelations and assumptions in risk evaluation (Pichery, 2014; Gorris & Yoe, 2014). There are two primary methods: local sensitivity analysis, which investigates small input changes based on linear assumptions, and global sensitivity analysis, which looks at the entire spectrum of input variations to account for nonlinear and multivariate influences. The former offers broader understanding by connecting total input uncertainty with output uncertainty (Gao et al., 2016).

2. Methodological approach

The study is conducted into 4 main phases, those are problem identification and formulation phase, data collection phase, analysis and interpretation, and lastly conclusion and suggestion.

a. Problem Identification and Formulation Phase

In this phase, two concurrent activities were conducted: literature review and object study. The purpose of the literature review is to bolster the theoretical foundation used in this research, while the object study aims to provide a detailed perspective on the subject of observation. The literature review will encompass various materials including but not limited to occupational accidents, productivity and return-to-work, government national health systems, risk management, and previous studies. In the object study, activities will involve interviews with relevant stakeholders and conducting a preliminary seminar on rehabilitation engineering. The final step of this phase is to formulate research questions along with identifying limitations and assumptions.

b. Data Collection and Processing

In the data collection phase, several key pieces of information were identified as essential for this study. These include the total number of individuals in the specified field of interest, the incidence of work-related accidents, coverage provided and private insurance, costs of assistive devices, Indonesia's inflation rate, insurer coverage, and existing treatments along with associated costs. The data collection process consists of four main phases: creating a risk matrix, identifying rehabilitation alternatives, assessing the outlook of insurance companies, and conducting scenario analysis.

- **Risk matrix creation.**

The primary objective of creating a risk matrix is to systematically map out risk factors, determine risk appetite, and calculate the Risk Priority Number (RPN). This process is crucial as it allows stakeholders to understand the severity of each risk factor and assess the probability of success for return-to-work initiatives. Initially, two datasets from IAOE will be utilized to analyse patient data entry. By examining the end status of each entry, the author can propose a risk matrix plan. Higher probabilities of patients not returning to work indicate higher risk levels. Additionally, occurrence is calculated as a percentage to further evaluate risk factors.

- **Rehabilitation and Alternatives Cost.**

The next stage entails calculating the expenses associated with return-to-work for the employees. This procedure is performed by utilizing the second dataset, which contains comprehensive compensation and benefits data. To account for the natural variability and uncertainty in the data, the dataset undergoes processing through simulation methods to produce tri-point estimates, representing optimistic, most probable, and pessimistic values. These tri-point estimates act as essential components for developing various scenarios, which are subsequently utilized in scenario analysis to assess possible results based on different assumptions and circumstances. Using this method allows for a more thorough evaluation of the financial effects of return-to-work strategies, considering both past trends and possible future variations in compensation expenses. This approach guarantees that the analysis stays strong, offering decision-makers a detailed insight into potential cost fluctuations and related risks

- **Scenario analysis.**

The goal of scenario analysis, as its name suggests, is to outline and evaluate potential funding scenarios for insurers and patients, aiming for improvement. To create scenarios, the author will adjust the contributions from beneficiaries to clients, increasing or decreasing them. The scenario analysis is based on the success rate of return-to-work. Once cash flow and NPV are generated, they are compared to the baseline condition, and the results are presented to experts to ensure they remain within acceptable parameters. Once all scenarios are mapped, sensitivity analysis is conducted. This involves adjusting the factors under consideration while holding all other variables constant.

In the subsequent stage of processing the data, a Monte Carlo simulation was performed with Minitab 19 to guarantee consistent and dependable outcomes. Medical cost distributions were represented using a lognormal distribution founded on past spending trends, whereas worker premium contributions were presumed to adhere to a normal distribution. For workforce forecasts, Holt’s exponential smoothing was chosen after evaluating it against Winter’s model and moving average, employing MAPE as the criteria for selection. The 2015 anomaly was regarded as an outlier and adjusted through winsorizing to prevent distortion. Concerning assumptions, an initial baseline of a steady 3.5% inflation rate was applied; nevertheless, to address long-term uncertainty, sensitivity analysis examined alternative inflation rates varying from 2–8%. Additionally, possible government policy changes were represented in scenario differences, guaranteeing that outcomes are not merely reliant on fixed assumptions but stay strong amid varying macroeconomic and regulatory environments.

c. Analysis and Interpretation

This phase serves a dual purpose: analyzing the data and interpreting the results as shown in Figure 3. While the previous phase outlined how the data would be processed, in this phase, the processing methods and the resulting interpretations will be discussed in much greater detail. Each sub-step of the data processing stage will be thoroughly explained and elaborated upon.

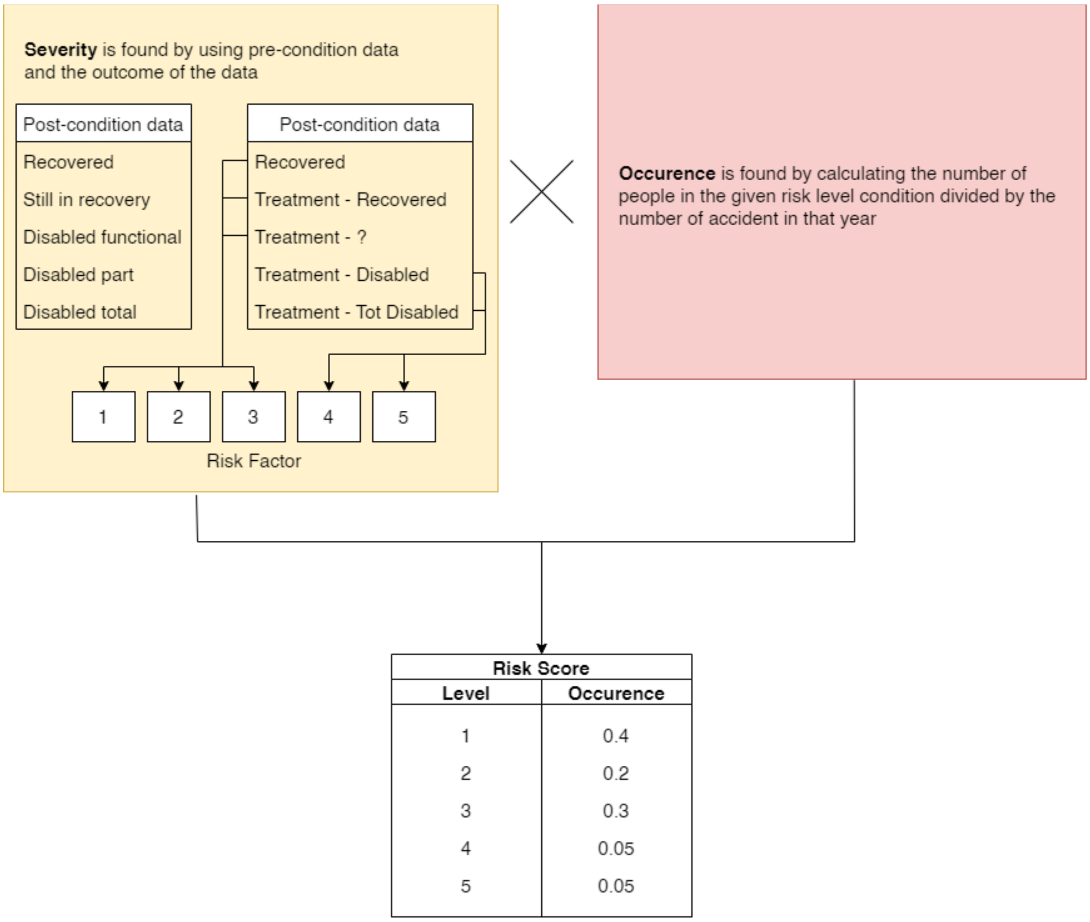

Figure 3. Data Processing Risk Matrix

d. Conclusion and Suggestion

The conclusion and suggestion phase acts as the last step to thoroughly address the research objectives. During this phase, essential findings are condensed, and actionable suggestions are developed for pertinent stakeholders. Moreover, recommendations and insights are provided to steer future research endeavors concentrating on analogous subjects, guaranteeing that later investigations can expand upon the existing results and enhance the wider knowledge base.

C. DISCUSSION

a. Data Collection

Supporting documents were obtained through interviews and by collecting data from the ministry via online repositories. Table 4 displays occupational accident data in East Java from 2019 to 2021. There are two versions of this data: one from the East Java recapitulation and another from the central data provided by the Ministry of Manpower.

TABLE 4
Occupational Accident in East Java 2019 – 2021

Year	2019	2020	2021
In workplace	985	19,668	12,118
Outside workplace	323	4,008	2,256
Traffic	558	10,039	5,756
Total	**1,866**	**33,715**	**20,130**

In East Java, Surabaya presents the highest case of occupational accidents as the province's largest city. A critical aspect of the study involves determining the rate of return to work for individuals affected by work-related accidents. Figure below presents a detailed breakdown of individuals returning to work in 2022, and illustrates the official success rate of return to work in 2020.

b. Data Processing

The initial analysis started with projecting the number of formal workers in the Surabaya. Figure 4 displayed the calculated forecast of the workers for the next 10 years, while Table 5 highlighted the generated numbers of the forecast.

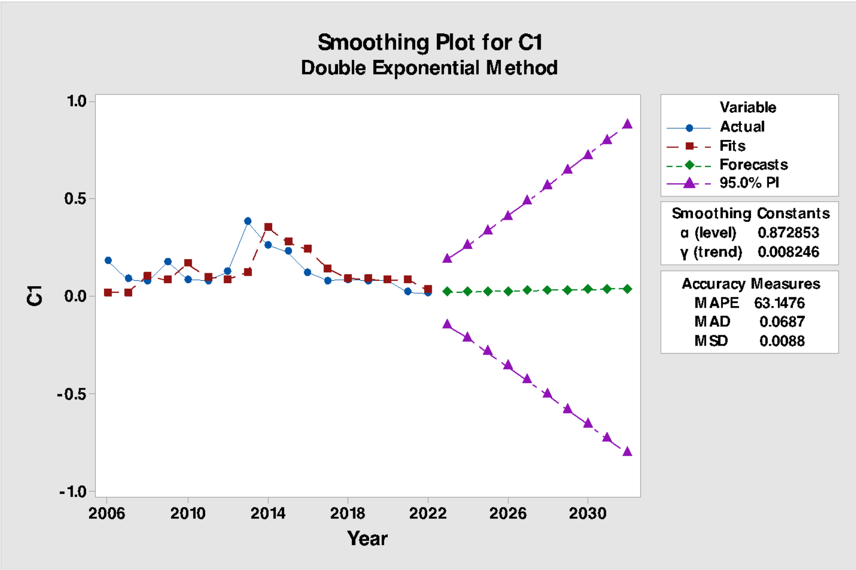

Figure 4. Surabaya Worker Forecast

TABLE 5
Tabulated Surabaya Worker Forecast

Period	Lower	Forecast	Upper
2021	907,478	1,196,806	1,486,134
2022	570,793	895,584	1,220,376
2023	542,707	910,421	1,278,135
2024	403,547	819,339	1,235,131
2025	708,610	1,176,046	1,643,483
2026	358,392	879,982	1,401,572
2027	316,944	894,490	1,472,037
2028	170,109	804,939	1,439,770
2029	462,175	1,155,286	1,848,398
2030	112,220	864,379	1,616,538

The steps of the forecast were as follows. Initially, several scenarios of forecasting techniques were prepared for consideration. Given the availability of historical data on the number of formal workers, an exponential smoothing technique was chosen. Among the three available exponential smoothing techniques, a comparison of forecast errors was conducted to determine the most suitable method. Winter exponential smoothing emerged as the preferred technique, as it yielded the smallest error, with values of alpha, beta, and gamma determined through an operational research technique. However, the Fourier test revealed an absence of seasonality in the data. Notably, a spike in the year 2015 occurred under unknown circumstances, attributable to resource unavailability for suggesting a spike.

Considering non-seasonal elements, various forecasting methods were assessed, such as moving average, single exponential smoothing, and Holt's model. Despite yielding the smallest error, single exponential smoothing estimated a steady future value and did not consider possible variations in the number of formal workers. To overcome this limitation, Holt's model—with a bit increased error—was chosen to account for future variability, utilizing alpha and beta values established through Minitab's ARIMA optimization. Appendix C includes comprehensive error comparisons featuring Holt's ARIMA-optimized model, Winter's model, and the moving average. According to the forecast, the estimated count of formal workers in Surabaya for 2023—the baseline year for simulation—was 840,578, not accounting for East Java or informal workers, aligning with the study's emphasis on the JKK scheme for formal employees exclusively. Additionally, the discovery that over 50% of cases are categorized as risk level 3 (prolonged therapy with uncertain outcomes) highlights the prevalence of outcome unpredictability in rehabilitation. From an academic viewpoint, this underscores a discrepancy between the structure of return-to-work initiatives and the real efficacy of medical rehabilitation, aligning with risk management theory regarding outcome uncertainty (Hubbard, 2020). From a policy perspective, it indicates the necessity for more flexible premium models or incentive systems that can address the significant unpredictability of healthcare expenses.

c. Modelling and Process Results

The model heavily relies on the Monte Carlo simulation technique to generate projections. Its ultimate goal is to produce a projected net present value for each scheme scenario, illustrating the culmination of the entire process. Costs and risk analysis results are then adjusted with inflation and increase of expenditures. In this study, the author acknowledges numerous limitations and assumptions, distinguishing it from other studies. Tables 8 provides a comprehensive summary of assumptions, along with their implications for the research.

TABLE 6
Assumptions and Research Implications

No	Assumptions	Implication on research
1	There were no significant fluctuations in hospitalization rates or changes in government policies observed during the observation period.	This research will exclusively analyze normal conditions.
2	The government did not employ significant measures to reduce work accidents; consequently, the accident rate remained unchanged.	This justifies the use of a fixed probability of occupational accidents in the calculation, as there is no available government data indicating a significant reduction in the national accident probability.
3	Transactions are assumed to take place monthly, consistently occurring at month-end, and remain unchanged unless influenced by inflation.	This serves to validate the model's calculation, which bases the financial assessment on the final period.

No	Assumptions	Implication on research
4	Cases are assumed to occur within a one-year timeframe and are independent of both previous and subsequent years.	-
5	Premiums, which serve as cash inflows for the cash flow analysis, are assumed to be uniform between patients and non-patients.	Proportionate premiums will be generated, although they will not accurately mirror real-world conditions, potentially resulting in significantly higher premiums.
6	There is no source of income apart from the premiums being paid.	The research will not be overly complex, but the results may differ because income from other sources may or may not outweigh premiums, thus impacting the balance between cash inflows and outflows.
7	The applied inflation rate stands at the current 3.5%, and the increase in medicine expenditure is assumed to be constant.	-
8	The entries from the dataset are assumed to represent the actual costs incurred.	-

d. Analysis of the Existing Scheme

The existing plan mandates that formal employees contribute monthly in return for benefits. Although Pal (2012) emphasizes the threat of Out-of-Pocket (OOP) expenses when insurers do not fully cover treatment, the JKK scheme guarantees care until recovery. Nonetheless, it remains unclear if these contributions significantly aid governmental efforts in promoting return-to-work. This research fills this void by utilizing comprehensive 2020 patient information from East Java. A small-scale simulation represents real scheme conditions, whereas a larger-scale model utilizes a collectivist method, combining monthly premiums for the benefit of all. Surabaya was selected for analysis because of its significant number of documented workplace accidents.

TABLE 7
Risk Level and Definition

Level	Name	Definition
1	Recovered	The patient has been labeled as recovered and does not require any further check-ups.
2	Treatment - recovered	Patient requires several consultations before being categorized as fully healed
3	Treatment - Undetermined	Patients are still undergoing treatment, and their status remains unconfirmed, or they have been undergoing treatment for an extended period without showing signs of recovery within the current observed time horizon

Level	Name	Definition
4	Treatment – Anatomically or functionally disabled - recovered	The patient is considered healthy; however, they were initially labeled as disabled. It is assumed that these individuals participated in a return-to-work (RTW) program.
5	Treatment - Anatomically or functionally disabled	The patient has undergone treatments and has been labeled as disabled, whether functionally or anatomically. Unlike level 4 patients, these individuals are not classified as healed during the observation time horizon.
6	Treatment - total disability	Patient has undergone treatments and has been labelled as totally disabled.

The research aims to evaluate if present expenditures and anticipated utilization of the program are adequate to alleviate the disadvantages of workplace accidents. Utilizing a risk management strategy to outline accident results, the study deviates from traditional techniques by classifying risks according to outcomes, with probabilities detailed in Table 8. This method is required due to the lack of expert agreement on generalized accident results. To address the uncertainty, the author calculates risk levels based on outcomes, intending to forecast workers' return to work irrespective of the type of accident. This research employs a risk matrix and sensitivity analysis, functioning not only as a technical exercise but also reflecting the fundamental principles of risk management theory (Hillson & Murray-Webster, 2017), emphasizing the significance of evaluating likelihood and consequences. While tools like NPV and Monte Carlo are commonly utilized, their use in this context is novel as it concentrates on post-injury circumstances, a frequently neglected element. This guarantees that the framework is easily adjustable for policymakers and academically significant by connecting financial evaluation with the socio-economic issue of enhancing productivity in return-to-work initiatives.

TABLE 8
Risk Levels Probabilities

Risk Level	Sum	%
1	1,163	38.81%
2	243	8.11%
3	1,529	51.02%
4	13	0.43%
5	49	1.63%
6	0	0.00%
SUM	**2,997**	**100.00%**

More specifically, Level 1 refers to patients who have undergone treatment until they recover, whereas Level 2 includes several treatments prior to healing, with each claim indicating an individual treatment. The frequency of treatment increases the severity of risk, impacting benefits. Levels 3 to 5 present uncertainties regarding outcomes, disabilities, and possible wage loss, whereas level 6 signifies complete disability, rendering a return to work improbable. The analysis encompasses probabilities at every tier, with level 3 being the most frequent, indicating uncertainty in outcomes. Levels 4–6 suggest possible disability and minimal participation in return-to-work initiatives. Costs are included as well, increasing with severity; repeated entries are aggregated, and level 3 costs fluctuate because of treatment ambiguity, while levels 4 and 5 entail significant medication and benefit costs. The model also includes revenues gathered by the Insurance Administration Organization (IAO) through premiums taken from employees' salaries. The table below outlines the number of workers by sector along with their associated risk levels, indicating premium rates specific to each industry.

TABLE 9
Filtered Industry and Study Risk Levels

Industry Risk	lv 1	lv 2	lv 3	lv 4	lv 5	lv 6
1	537	85	858	3	24	
2	84	14	108	3	1	
3	485	122	426	6	22	
4	33	7	70	0	1	
5	24	15	67	1	1	
SUM	1163	243	1529	13	49	

Table 9 is presented to ascertain the distribution of individuals across different risk levels within their respective industries. Government Regulation No. 44 of 2015 categorizes industries into "high risk," "medium risk," and "low risk" without further detail. Hence, the assumption is made that this classification is based on severity and the likelihood of accidents occurring in the workplace. However, upon mapping these industries to their respective risk levels, no direct correlation is evident. Surprisingly, industries classified as "extreme risk," with a premium rate of 1.74% of monthly wages, have fewer workers than those in "medium risk" and "low risk" categories. This discrepancy challenges the notion that higher risk levels correspond to increased accident probability or workers being unable to return to work. Conversely, individuals in low to medium risk categories appear to be more susceptible to accidents, potentially attributed to the prevalence of small and medium-sized enterprises (SMEs) in Surabaya.

The model presently targets risk levels 1 through 5, omitting level 6 (total disability impairment), since no instances were noted in Surabaya in 2020. Intermittent records from various years and locations indicate that total disability continues to be an uncommon event, corroborating the results of Berkowitz & Burton (1987), who found that permanent total disability instances represented merely 0.10%–0.16% of all yearly cases in the United States from 1958 to 1982. Even though level 6 cases are unlikely, their possible seriousness and lasting financial and social consequences highlight the necessity of considering these extreme scenarios in risk evaluations. Integrating monitoring systems and backup plans for these uncommon yet significant incidents guarantees that the model stays resilient and responsive to the complete range of possible risks in the workforce.

Financial forecasts for the coming decade, based on stable premiums with fluctuations in workforce and medication expenses modified for inflation, indicate that the present IAO plan is mostly adequate under typical conditions, showing NPVs of IDR 3,305,646,957,621.68; IDR 2,484,298,327,708.91; and IDR (8,624,435,707,232.48) for low, medium, and high employment predictions, respectively. Negative NPVs emerge in situations with high expenses or significant risks, signifying possible shortfalls. Bidirectional analyses to reach net-zero NPV indicate that modifying premiums or benefits is essential: in low expenditure cases, premiums might require a 98% cut, medium situations permit a 60%–80% decrease, whereas high expenditure scenarios necessitate a 76% average rise over a decade.

Increasing drug prices, estimated at 14% compared to a 2% rise in minimum wage, emphasize the necessity for policy reforms to ensure sustainable benefits.

TABLE 10
10-Year Projection NPV Expenditure Cost

Period	Maximum Cost Cashflow	Average Cost Cashflow	Minimum Cost Cashflow
1	3,302,378,703.94	227,952,405,066.59	266,652,081,966.54
2	(25,204,411,737.85)	236,367,068,230.55	281,430,092,403.04
3	(57,252,528,023.46)	245,566,261,144.06	297,733,732,839.46
4	(93,686,100,620.02)	255,211,061,589.48	315,324,504,935.89
5	(134,673,845,005.21)	266,115,177,813.87	335,153,890,298.30
6	(181,945,927,862.44)	277,006,455,420.53	356,075,883,749.92
7	(235,704,794,161.52)	288,637,532,104.76	378,959,517,770.57
8	(296,655,687,174.98)	300,987,536,899.49	403,941,419,140.76
9	(366,639,152,462.47)	314,026,463,956.32	431,276,795,721.84
10	(446,426,076,974.69)	326,884,641,846.09	460,105,150,539.76
NPV	(1,411,063,242,905.60)	2,251,775,740,210.36	2,882,772,142,587.19

Continuing from the previous paragraph, the analysis shifts focus to benefits. Costs required for all risk levels are rearranged relative to the highest cost, level 5 treatment, to ascertain the maximum tolerable cost considered neutral. Under maximum conditions, the maximum tolerable cost one year into the future is IDR 25,370,681.67; IDR 89,184,467.59; IDR 82,933,474.53; IDR 104,593,164.58; and IDR 125,686,881.91. A significant increase in benefits to achieving a zero NPV occurs under average and low scenarios, while a reduction occurs under the maximum scenario. This underscores the need to increase benefits in average and low-expenditure environments to balance payment and benefits effectively.

Estimating the average cost of total disability is challenging due to insufficient data, but Berkowitz & Burton (1987) indicated an average treatment cost in the U.S. of $92,055 from 1978 to 1982, which translates to IDR 3,702,448,851.50 in 2020; nonetheless, variations in healthcare systems restrict direct relevance to Indonesia, emphasizing the necessity for additional study on rehabilitation costs for risk level 6 cases. Moreover, the research includes increasing accident rates as indicators of net cash flow to evaluate the extra funding IAO might need for broader coverage or preventive actions. Ahmad et al. (2022) recognize seven themes for possible investment: occupational safety and health management, organizational leadership, safety culture, training, communication, risk, and legislation.

TABEL 11
Proposed Cost for Zero Accident Investment

Scenario	Proposed Cost
Max	IDR 2,895,383,857,256.71
Average	IDR 379,137,577,785.08
Low	IDR 24,519,520,541.41

Table 11 outlines the government's projected spending over the next 10 years to mitigate accident risks, assuming no increase in IAO coverages. In the maximum scenario, an estimated budget of IDR 2,895,383,857,256.71 is required to achieve zero accidents. This reflects the significant costs associated with high benefits reimbursements, likely resulting in greater insurer payouts. The average scenario suggests a more probable budget of IDR 379,137,577,785.08, aligning with average claims amounts and representing the central limit for IAO expenditures. In the low-expenditure environment, only IDR 24,519,520,541.41 is allocated for accident prevention efforts, reflecting minimal insurer payouts and a lower risk environment.

This examination examines the financial elements of the program, offering numerical insights and integrating personal viewpoints from the insured to guarantee a thorough comprehension. Interviews uncovered deficiencies in JKK coverage, as certain companies opt out, forcing patients to depend on company assistance with minimal government involvement. Patients noted the significance of peer support in recovery, reflecting the views of Franche et al. (2005), who pointed out the difficulties encountered by injured workers after an accident and warned against rushing back to work to avoid setbacks or reinjury. Additional analysis of reimbursement advantages, utilizing 5,434 data points and the 50th percentile approach, evaluated delays and possible shortfalls in maximum spending situations. Statistical findings validated that the unmodified model accurately portrays the existing scenario, although firms and informal workers could incur initial costs prior to reimbursement, aligning with the results by Dang et al. (2021) regarding out-of-pocket costs and restricted coverage.

The research additionally offers different scenarios for IAO policyholders, modifying premiums by ±10%, accident rates by ±40%, and benefit costs by ±50%, while including sensitivity analysis that accounts for wage and worker variability. Findings show that benefits compensation significantly affects net cash flow, influenced by increasing treatment expenses, especially for high-risk employees. Premium rates are the second most significant element, directly impacting IAO revenue in connection to workforce size. Changes in accident rates have a moderate impact, limited by static healthcare costs, while wage hikes have little effect because of their slow progression and the percentage-based premium calculation. These results offer essential insights for policy modifications, highlighting the necessity to balance premium frameworks, benefit offerings, and accident oversight to ensure financial viability.

D. CONCLUSIONS AND FUTURE RESEARCH

The findings of this research highlight major shortcomings in the present employment coverage and workplace accident plans of Insurance Administration Organizations (IAO), indicating that impacted employees frequently struggle to regain their full productivity. The six-tier risk framework indicates that employees in levels 1 and 2 possess over a 70% likelihood of returning to work, whereas level 3 cases show only a 51% probability, and levels 4 and 5 drop below 5%, underscoring the necessity for specific interventions. While level 6 cases are infrequent, showing a 0% occurrence in the data collected, they highlight the necessity of preparing for extreme results. Projections for the next ten years suggest that the plan is viable under average or low compensation conditions; however, with maximum compensation costs, the NPV shifts to negative at IDR (1,411,063,242,905.60), indicating possible financial pressure. The highest coverage for each severity level to attain a net-zero NPV varies between IDR 25,370,681.67 and IDR 125,686,881.91 in the maximum case and from IDR 9,853,782.53 to IDR 100,834,028.92 in the average case.

These findings have obvious implications for policy. IAO needs to modify premium frameworks and benefit limits to guarantee fair employee assistance and financial viability. The highest potential funding for preventive programs amounts to IDR 2,895,383,857,256.71 in the optimal scenario, creating chances to decrease workplace accidents, particularly in high-risk industries. Sensitivity analysis reveals that treatment costs, premium rate adjustments, accident frequency, and wage changes are the key factors influencing net cash flow, ranked from most to least impactful. This showcases that managing these variables proactively, along with flexible policies and funding in preventive actions, is crucial for upholding a sustainable and efficient program that caters to the requirements of both the workforce and the government

Studies on return-to-work rates and insurance coverage in developing countries is scarce, even though they play a crucial role in developing effective worker protection initiatives. Although studies in developed nations have offered valuable information on return-to-work mechanisms and the effectiveness of insurance, the absence of comparable research in developing regions restricts the development of customized programs that effectively assist injured employees. This research tackles the gap in Surabaya by combining financial modeling (NPV and Monte Carlo simulation) with a risk management framework to assess the sustainability of the JKK program, providing insights into probabilities of returning to work and insurance impacts. Nonetheless, concentrating on one city and depending on specific macroeconomic assumptions restricts generalization, indicating the necessity for future research across various provinces with wider variables like GDP growth and new workplace health regulations. Moreover, a cohesive data system is critically required to streamline monitoring and guarantee that both physical and financial assistance for accident victims can be provided more efficiently and sustainably.

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