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# SIMULATION MODELING OF EVACUATION IN DEVELOPING AN EMERGENCY PREPAREDNESS PLAN

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**Purpose:** The purpose of the research was to demonstrate the feasibility of using an application for modeling the evacuation of people, for the decision support process during the development of emergency preparedness plans requiring the evacuation of products from the warehouse.
**Design/methodology/approach**: Pathfinder software was used during the analysis. It allowed mapping the space of an example warehouse and simulating the movement of internal transport (forklifts) in it. The study was conducted for sample scenarios of events requiring evacuation.
**Findings:** Simulations of product evacuation in the warehouse made it possible to determine evacuation times. A categorization of production by value was made, establishing different sequences of their removal from the warehouse. This made it possible to optimize the location of products in the warehouse and the actions of forklift operators during evacuation. These findings can be incorporated into the emergency response plan required in safety management systems.
**Research limitations/implications**: The results of the study refer to a case study company, and the scenarios are specific to the company. However, they exemplify a universal approach to the possibility of supporting emergency planning requiring the evacuation of property.
**Practical implications:** The paper presents a procedure scheme for planning emergency preparedness using evacuation simulation modeling. An example of using human evacuation modeling software to simulate the evacuation of products from a warehouse is presented.
**Originality/value:** The article includes a unique example of using a human evacuation simulation modeling application to model the evacuation of pallets of products in a warehouse.

Keywords: simulation modeling, emergency situations, safety management.

**Category of the paper:** research paper, case study.

## 1. Introduction

Methods of preparing for emergency situations in companies are part of the guidelines for implementing occupational safety management systems (Dahlke, Idczak, 2021; Dahlke, 2022; PN-ISO 45001; ISRS; OHSAS 18001; PN-N-18001; SCC 2004/4; Pearse W., 2002; Redinger

C.F., Levine S.P., 1998). The implementation of emergency procedures and instructions is aimed at reducing the consequences and costs of incidents (Dahlke, Idczak, 2021). One of the most important elements of the aforementioned guidelines is an emergency response plan (Dahlke, 2022; https://www.epa.gov/rmp; OHSAS 18001:2007; PN-ISO 45001:2018-06).

Emergency situations cause or can cause losses, which in the literature are divided into four categories (PEME) (Lelo, Purba, 2018):

- People.
- Equipment.
- Materials.
- Environment.

According to the EPA (United States Environmental Protection Agency), the Hazardous Release Risk Management Program (RMP, Article 112r) requires hazard assessments and emergency response programs. It includes (https://www.epa.gov/rmp):

- hazard assessment that details the potential consequences of an accidental release, the history of accidents over the past five years, and an assessment of worst-case and alternative release scenarios,
- prevention program including precautions and maintenance, monitoring and training measures for workers, and
- emergency response program, which specifies emergency health care, means of training employees, and procedures for informing the public and response institutions (e.g., fire departments) in the event of an emergency.

The most important hazards in industrial plants include (Mannan, 2012):

- fires,
- explosions,
- release of toxic chemicals.

Expansion of a fire is a very rapid phenomenon and requires immediate intervention. In fire zones that border the zones in which the fire occurred, it is possible to take a loss-limiting action, which is the evacuation of property. You can prepare for it by planning:

- evacuation routes and transportation means,
- fire protection of transport routes and product storage areas,
- the sequence of evacuation based on criteria valuing property,
- training of persons responsible for evacuation.

The property evacuation plan can be supported by the use of computer simulation tools adapted mainly for modeling the conditions of occupant evacuation. Many computer softwares have been developed for this purpose. As examples can be mentioned: AnyLogic PLE, CrowdMaster, Evacs, EvacSim, Building Exodus maritime Exodus, Legion Simulator, Massive, MassMotion, Panic, Pathfinder, Pedestrian Dynamics, Simulex, Simwalk, Social Distances, Steps, Wayout and many others (Kuligowski, 2013; Dahlke, 2020). They have been

prepared mainly for modeling the behavior of people in buildings, but they can also be applied to transportation modes or areas outside buildings (Abdelgawad, Abdulhai, 2012; Gudowski, Wąs, 2006; Hedo, Martinez-Val, 2011; Ku et al., 2020; Melis et al., 2020; Wang et al., 2020).

Based on an analysis of the literature, it can be assumed that few publications are concerned for modeling the evacuation of products from the warehouse. Some of the papers in the field of logistics address the problem of logistics in crisis management (Grocki, 2010; Detzer et al., 2016), determining the general requirements for satisfying needs and flows of products. Evacuation is only possible if it does not require a risk of life and health of employees. The most probable scenarios involve taking action when an accident requiring evacuation develops, for example, in the vicinity of the warehouse building (e.g., an adjacent fire zone when the cause of evacuation is a fire). Evacuation planning should estimate the critical evacuation time (Siam et al., 2022) or, in the case of fire, the critical fire time (Hulida et al., 2019). In the case of hazardous events in warehouses, the most common concern is the evacuation behavior of people in the company/building (Joo et al., 2013; Kosinski, Grabowski, 2010; Shaik et al., 2019) or in the company's surroundings (Ikeda, 1982). Among the basic criteria for optimizing product placement in a warehouse are economic objectives (space usage, cost and transportation time) and environmental objectives ($CO_2$ emissions of transportation means) (Sadeghi et al., 2024; Mrówczyńska, Sladkowski, 2013; Sikora et al., 2015; Félix-Cigalat, Domingo, 2023).

The modeling of evacuation conditions using computer softwares is a widely used activity to support decision-making in both the design and correction phases of both buildings and organizational systems for safety.

The article presents a method of decision support during property evacuation planning using the Pathfinder application. The analysis was carried out on the example of a warehouse.

## 2. Methods

The process of modeling warehouse evacuation conditions using Pathfinder softwear requires the introduction of activities similar to modeling the evacuation of people. One of the most important planning steps is the preparation of accident scenarios for the example under consideration (**Figure 1**). Since each facility being modeled has its own unique characteristics, it is necessary to gather basic information.

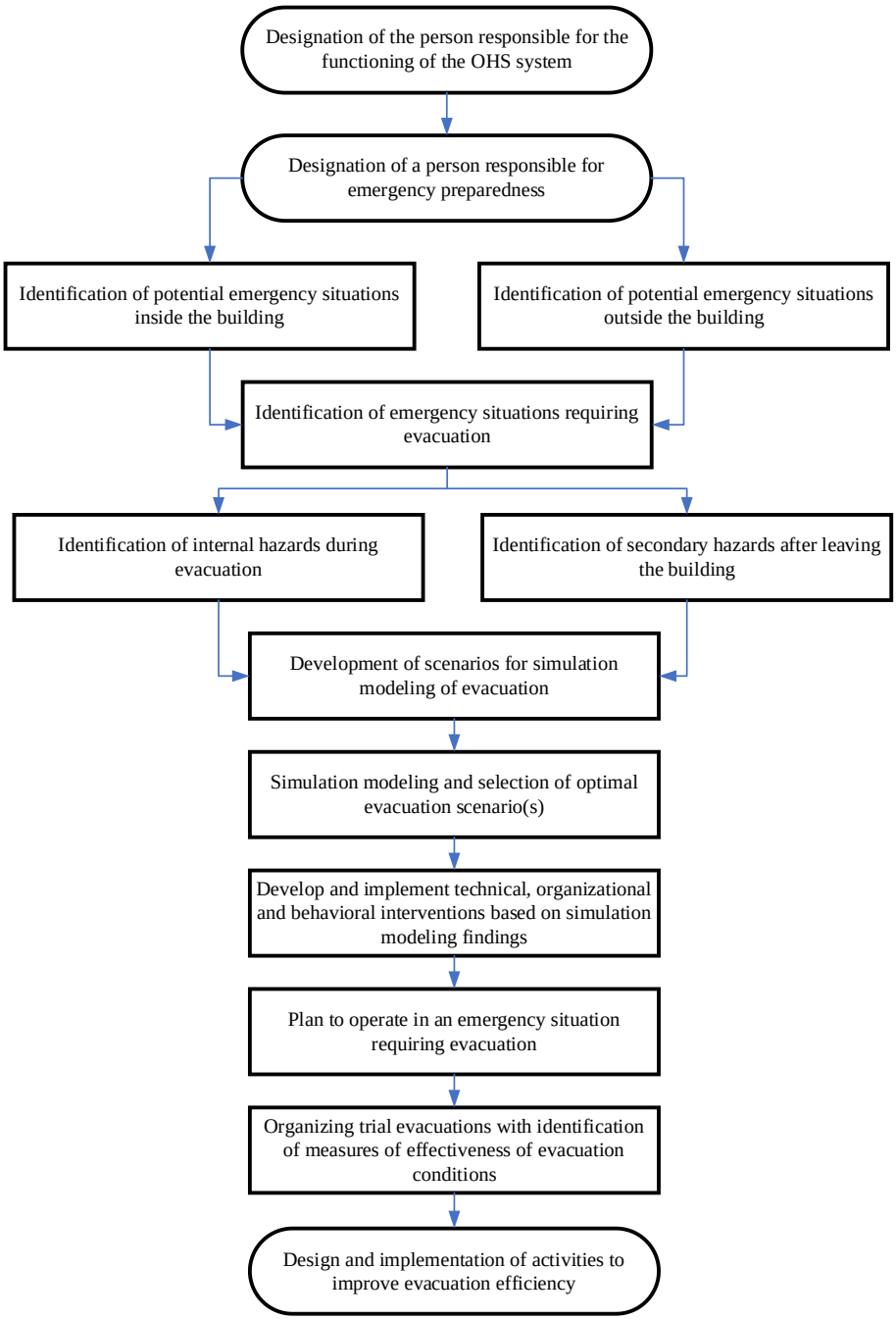



**Figure 1.** Diagram of the structure of emergency preparedness activities requiring evacuation, taking into account the results of evacuation simulation modeling (OHS – Occupational Health and Safety).

Source: Dahlke, Idczak, 2021.

The object to be analyzed in detail is a building with a warehouse-office-social function, which is a back office of an enterprise engaged in the distribution of products to stores, supermarkets, and wholesalers both in Poland and abroad. The building consists of a three-story social-office part and a one-story warehouse part, which is a high-storage logistics facility, where the assortment is stored by pallet, and a given pallet contains only one group of products. It was assumed that the assortment in the warehouse is divided and stored according to their functionality. Pallets on the racks are stored in such a way that the heaviest ones are on the

lowest level, while the lightest ones are as high as possible - this is due, among other things, to the technical limitations of transport trucks, but also to ensure safe working conditions for employees. The warehouse section is serviced by 6 Jungheinrich ETV 110/112 reach trucks, 4 PRA 2500/11150 G/PT hand pallet trucks and 3 LION-TRUCK PLUS electric pallet trucks.

The total height of the building was about 15 m, and the first floor area was equal to 1995 $m^2$. The building was equipped with fire protection devices, i.e. a fire alarm system, an audible warning system, a fire power switch, a gravitational smoke removal system, fire dampers and an external and internal hydrant system.

In mapping the building, drawings of top views of each room were first prepared in AutoCAD and exported to Pathfinder (Figure 3, Figure 4). Shelving in the storage area, office furnishings (desks, chairs and cabinets) were plotted on the floor plans (**Figure 2**).

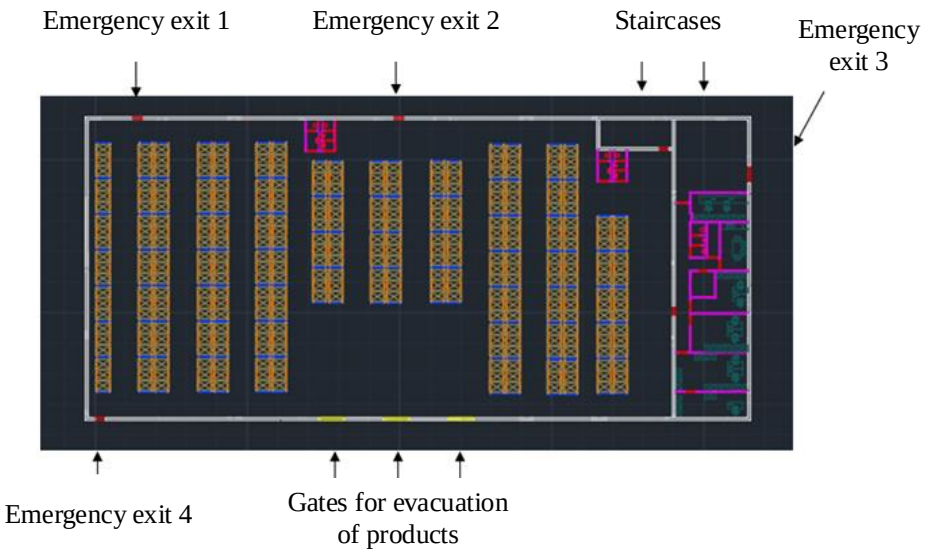



**Figure 2.** First floor plan of the surveyed building.

Source: Sopoćko, 2019.

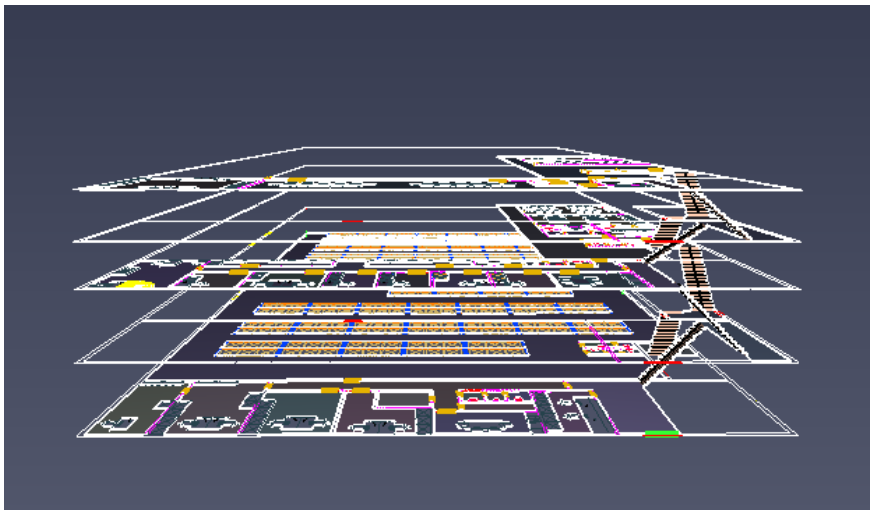


**Figure 3.** A rendering of the building including the warehouse in Pathfinder softwares.

Source: Sopoćko, 2019.

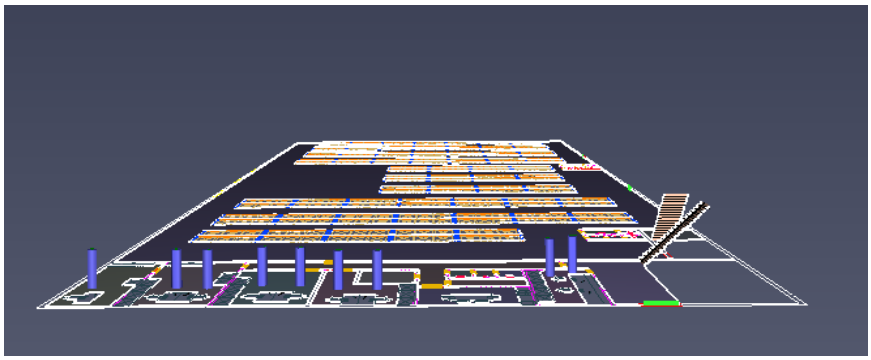


**Figure 4.** First floor plan after occupants input made in Pathfinder softwear.

Source: Sopoćko, 2019.

In a similar approach to the evacuation of people, it is necessary to show the details of objects moving in the evacuation area, which are the forklifts (**Figure 5**). Their task will be to move products from a rack to a designated storage area. During the simulation, the forklift takes the shape of a solid, or more precisely, a prism. In a similar way to the evacuated occupants, they are assigned behaviors that will correspond to the developed event scenarios.

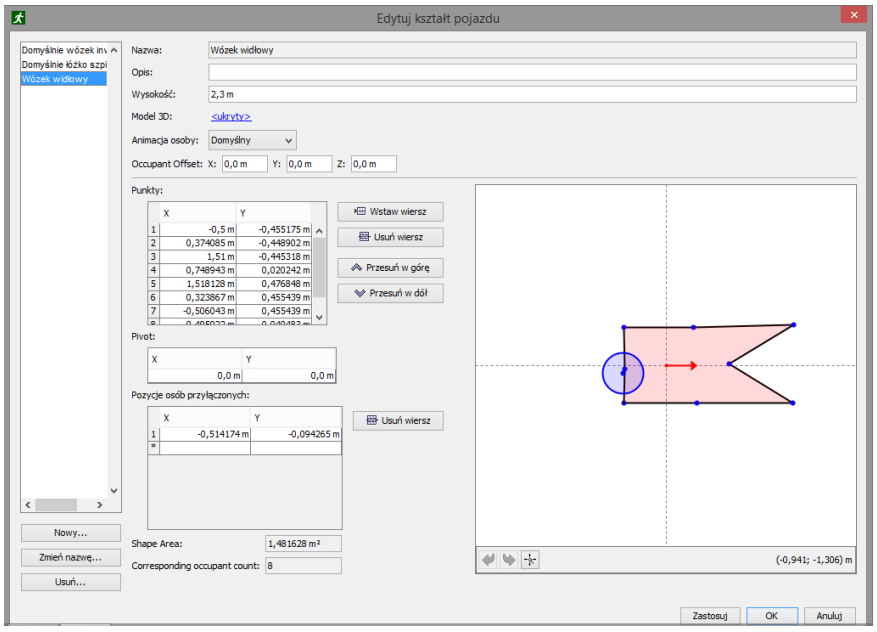



**Figure 5.** Forklift model made in Pathfinder software.

Source: Sopoćko, 2019.

The figure below (**Figure 6**) shows the distribution of assortment on each rack. When optimizing the order of pallets evacuation with products, it is necessary to introduce weight criteria, for example, the value of products on a pallet. Products were assigned value classes according to a five-point scale (Table 1):

- 1 – Value of product up to 80 PLN.
- 2 – Value of product up to 120 PLN.
- 3 – Value of product up to 170 PLN.
- 4 – Value of product up to 200 PLN.
- 5 – Value of product up to 200 PLN.

**Table 1.**

*Type and evaluation of the assortment's value*

| Marking the storage area | Type of assortment | Value assessment |
|---|---|---|
| **1** | **2** | **3** |
| **A** | Assortment 1 | 2 |
| **B** | Assortment 2 | 1 |
| **C** | Assortment 3 | 5 |
| **D** | Assortment 4 | 2 |
| **E** | Assortment 5 | 4 |
| **F** | Assortment 6 | 2 |
| **G** | Assortment 7 | 3 |
| **H** | Assortment 8 | 2 |
| **I** | Assortment 9 | 2 |
| **J** | Assortment 10 | 3 |
| **K** | Assortment 11 | 3 |
| **L** | Assortment 12 | 2 |
| **M** | Assortment 13 | 3 |

Source: Sopoćko, 2019.

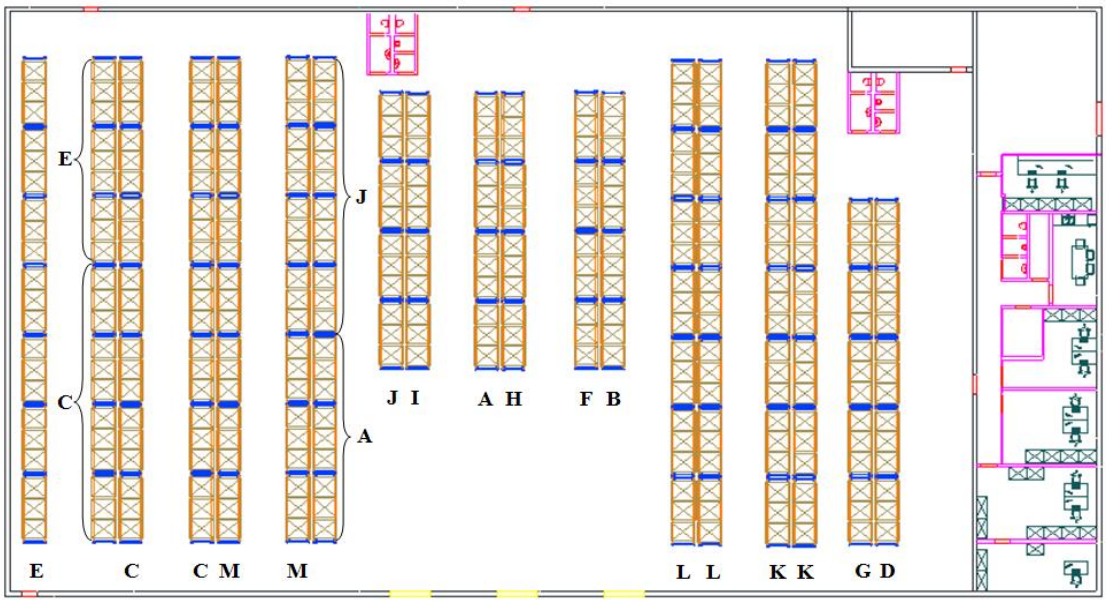



**Figure 6.** Distribution of individual assortment groups.

Source: Sopoćko, 2019.

Pallets of products were taken outside the warehouse by forklifts. Mapping this activity required drawing in additional space outside the warehouse building (**Figure 7**).

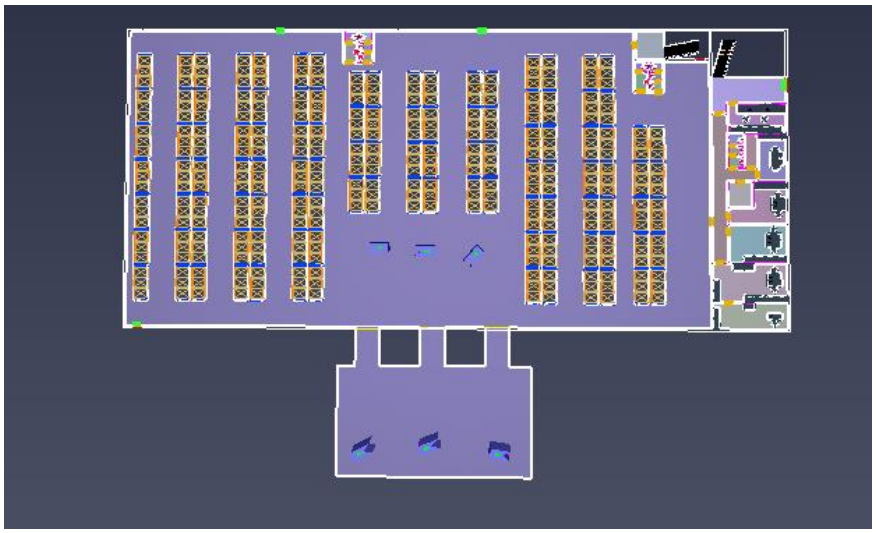


**Figure 7.** Building with additional space for product storage and forklifts.

Source: Sopoćko, 2019.

After preparing a model of the building and transport equipment, it is necessary to prepare scenarios of events requiring and affecting evacuation. They are included in Table 2.

**Table 2.**

*List of scenarios for modeling evacuation of property from a warehouse*

| Scenario No. | Characteristics of the incident requiring evacuation |
|---|---|
| **Scenario 1** | Evacuation from a warehouse rack containing L-type products by two forklifts inside and two forklifts outside the warehouse when two sectional gates are open. |
| **Scenario 2** | Evacuation from a storage rack containing Group L products by two forklifts that transport the product range directly to the outside, when two sectional gates are open. |
| **Scenario 3** | Evacuation of products by two forklifts from a rack containing Group C products in a warehouse. The forklifts transport the assortment directly to the outside through the open two sectional gates. |
| **Scenario 4** | Evacuation of products from a rack containing Group C products in a warehouse. Two forklifts work inside and two forklifts outside the warehouse. Two sectional gates are open. |
| **Scenario 5** | Evacuation of products by three forklifts using three sectional gates. The forklifts evacuate products directly to the outside. Imposed evacuation time - 2 minutes. |
| **Scenario 6** | Evacuation of products assuming three forklifts working inside and three outside the warehouse. Three sectional gates will be used. Imposed evacuation time - 2 minutes. |

Source: Sopoćko, 2019.

Mapping the accepted scenarios required specifying "behaviors" in Pathfinder's software enabled:

- indicating the location of the points to which the transport forklifts were to be moved (inside and outside the warehouse),
- forcing a stop when a pallet with products is pulled off the rack,
- forcing a stop when pallet with products is put down.

The forklift's standstill time was determined by measurements during observation of the work process. The speed of the forklifts was about 2.78 m/s, that is, approximately 10 km/h. After the evacuation of property was completed, each forklift left the warehouse area through the additional evacuation gate.

# 3. Results

## 3.1. Scenario 1

In Scenario 1, it was assumed that Group L products would be evacuated. It was established that two forklifts operate inside and two outside the warehouse. The forklifts working inside the warehouse retrieve the product range and then transport it just outside the sectional gate. The standstill time for the forklift working inside is 10 seconds to remove a pallet from the rack and five seconds to put the pallet back in a specific place. Equipment working outside pulls up to where the pallets have been deposited by the warehouse forklifts, and then transports them directly to a safety location. The standstill time for external forklifts is assumed to be the same as for those working inside (Figure 8).

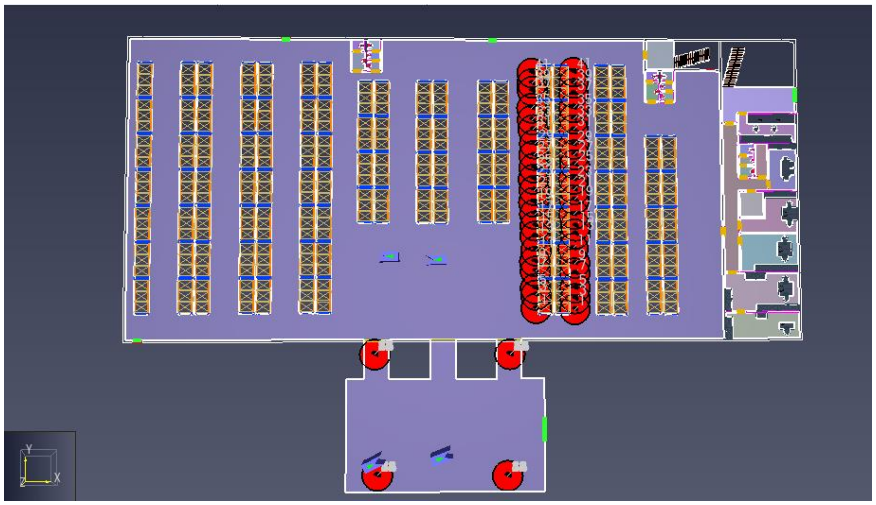


**Figure 8.** Evacuation of products - Scenario 1. Red circles mark points of movement of forklifts. Source: Sopoćko, 2019.

The evacuation time for the established scenario was 913 seconds. During the simulation, it was assumed that each of the operating forklifts would follow a specific path, so the property evacuation process itself went quite smoothly - there were no collisions between the cooperating forklifts.

## 3.2. Scenario 2

In order to compare the resulting times, it was assumed that the second scenario would be similar to the previous one. Forklifts operating inside the facility were assumed to transport products directly to a safe location. The stopping time is 10 seconds to remove the pallet from the rack and to put the pallet back at the destination (Figure 9).

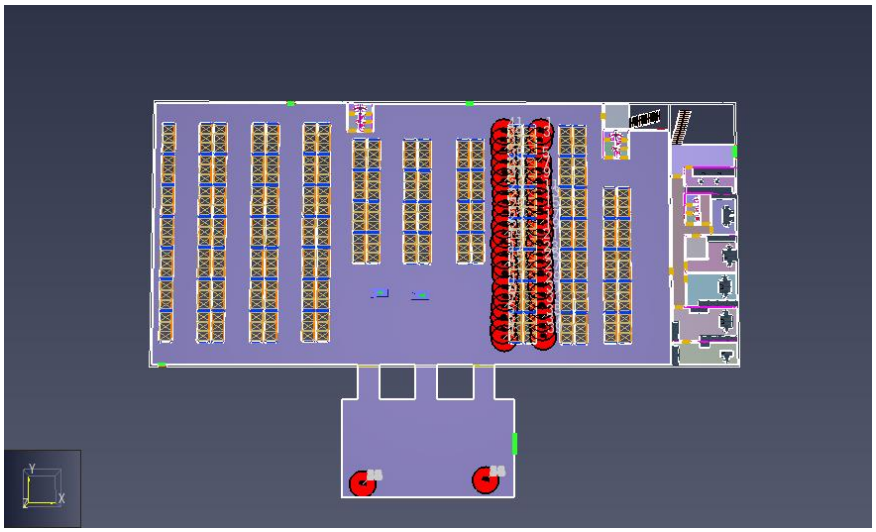


**Figure 9.** Evacuation of products - Scenario 2. Red circles mark points of movement of forklifts. Source: Sopoćko, 2019.

The resulting evacuation time using the assumptions of this scenario was 1044.3 seconds. As in the previous scenario, there were no collisions between operating forklifts.

### 3.3. Scenario 3

The warehouse contains a variety of assortments, but the highest-value portion is stored on the racks furthest from the entry gates. It was assumed that two forklifts evacuate part of this rack through two sectional gates. As in the previous variant, the forklifts retrieve the pallets with the assortment and transport them to the required location. A standstill time of 10 seconds was assumed for both loading and unloading (Figure 10).

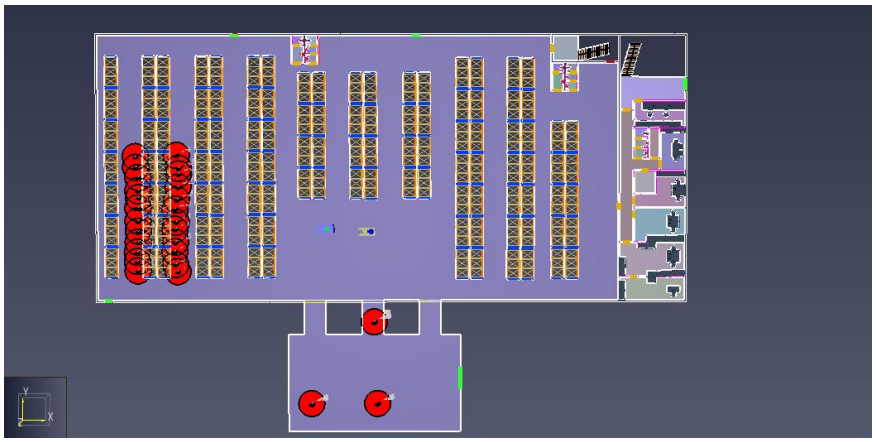


**Figure 10.** Evacuation of products - Scenario 3. Red circles mark points of movement of forklifts. Source: Sopoćko, 2019.

The evacuation time obtained using the assumptions of this Scenario was 665 seconds. During the simulation, the forklifts passed each other without causing a stop or prolonging the evacuation process. The equipment operated at its own pace, which was assumed beforehand.

### 3.4. Scenario 4

In order to compare the results, Scenario 4 involved the evacuation of products distributed in the same area as in Scenario 3. It was assumed that Group C products would be evacuated. Two forklifts were assumed to operate inside and two outside the warehouse. As in the previous scenario, the forklifts operating inside the warehouse retrieve the assortment and then transport it just outside the sectional gate, with a stopping time of 10 seconds to remove the pallet from the rack and 5 seconds to put the pallet back just outside the gate. In contrast, forklifts outside the warehouse retrieve pallets and transport them to their destination. A standstill time for them was assumed equal to 5 seconds to put the pallet on the forks and 10 seconds to remove it (Figure 11).

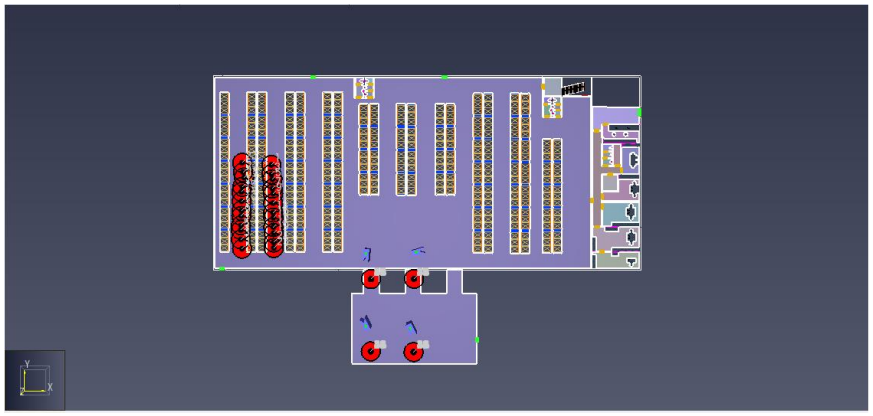


**Figure 11.** Evacuation of products - Scenario 4. Red circles mark points of movement of forklifts. Source: Sopoćko, 2019.

An evacuation time of 560.4 seconds was obtained during the simulation. As in the previous Scenario, there were no collisions. The devices performed their work according to the imposed "behavior".

### 3.5. Scenario 5

This variant assumes that it is necessary to evacuate from the warehouse products near the sectional gates, or more precisely the assortment of group A, I, J, H, F and B. Three forklifts will be used for the evacuation, which will transport the assortment to the outside. The scenario dictates in advance an evacuation time of 2 minutes, as beyond this time visibility and safe conditions of evacuation will decrease (Figure 12).

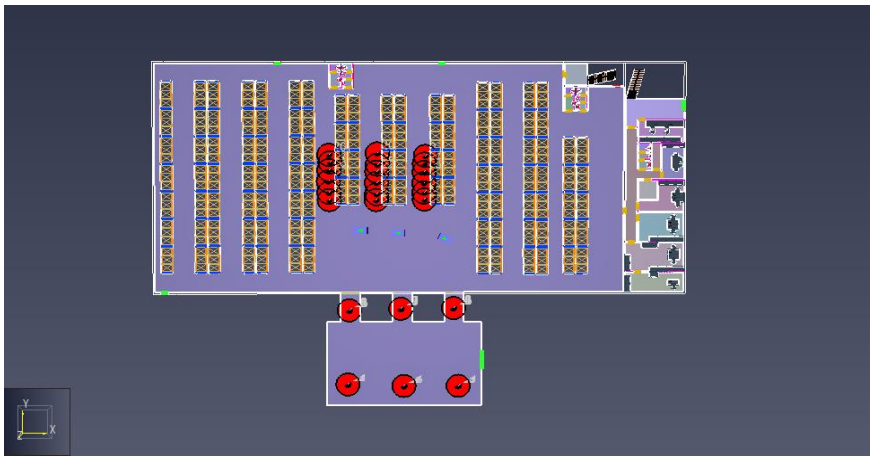


**Figure 12.** Evacuation of products - Scenario 5. Red circles mark points of movement of forklifts. Source: Sopoćko, 2019.

### 3.6. Scenario 6

In order to compare the resulting evacuation times and choose the optimal solution, it was assumed that Scenario No. 6, would be similar to Scenario No. 5. It was assumed that the goods of groups A, I, J, H, F and B would also be evacuated, and the evacuation time would be 2 minutes. The change that has been made mainly concerns the operation of forklifts. It has been planned that 3 forklifts will work both inside and outside. The equipment working inside picks up the goods and then transports them just outside the sectional gate. The stopping time is 10 seconds to remove a pallet from the rack and 5 seconds to put it back in a given place. The forklifts working outside already transport them to their destination, and their standstill time was 10 seconds (Figure 13).

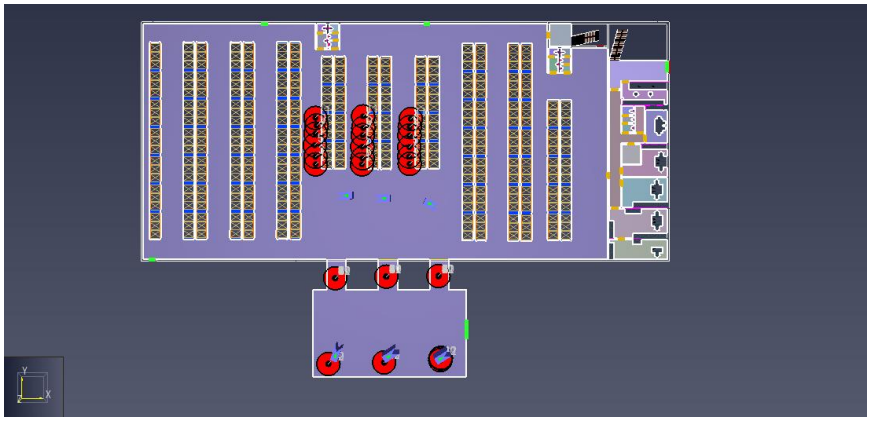
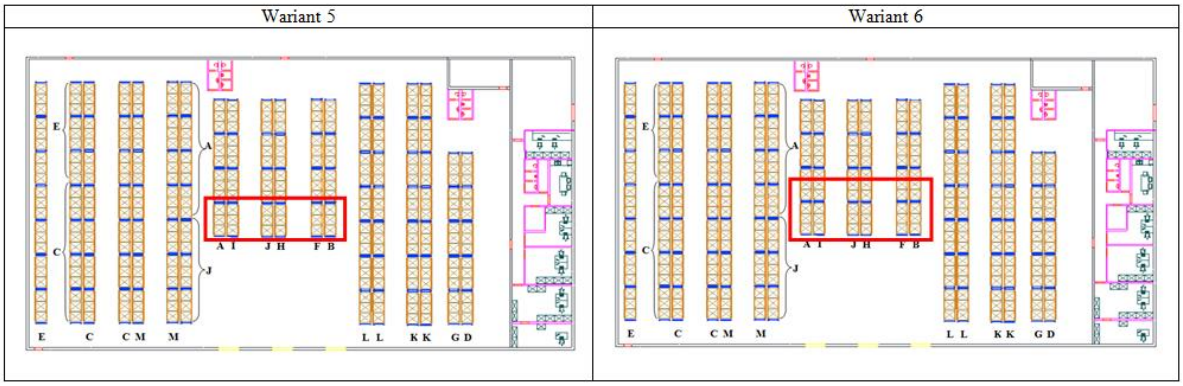


**Figure 13.** Evacuation of products - Scenario 6. Red circles mark points of movement of forklifts. Source: Sopoćko, 2019.

In the previous incident scenarios, the goal was to determine the evacuation time of the goods. In Scenarios #5 and #6, a fixed evacuation time was assumed (2 minutes), hence it was investigated what amount of assortment could be transported out of the warehouse. Table 3 presents a diagram of top views of the evacuated warehouse in two variants (Scenarios #5 and #6). With the help of red frames, the racks from which it was possible to evacuate the stored products within 120 seconds were marked. Based on the results obtained, it can be seen that with Scenario No. 5, forklifts operating inside the warehouse performed 3 full work cycles (that is, they retrieved the goods and placed them in a safe place), while with Scenario No. 6 - 5 cycles. The obtained results can provide a basis for introducing measures to improve the property evacuation process in the future.

**Table 3.**
*Comparison of the quantity of the evacuated product range*




Source: Sopoćko, 2019.

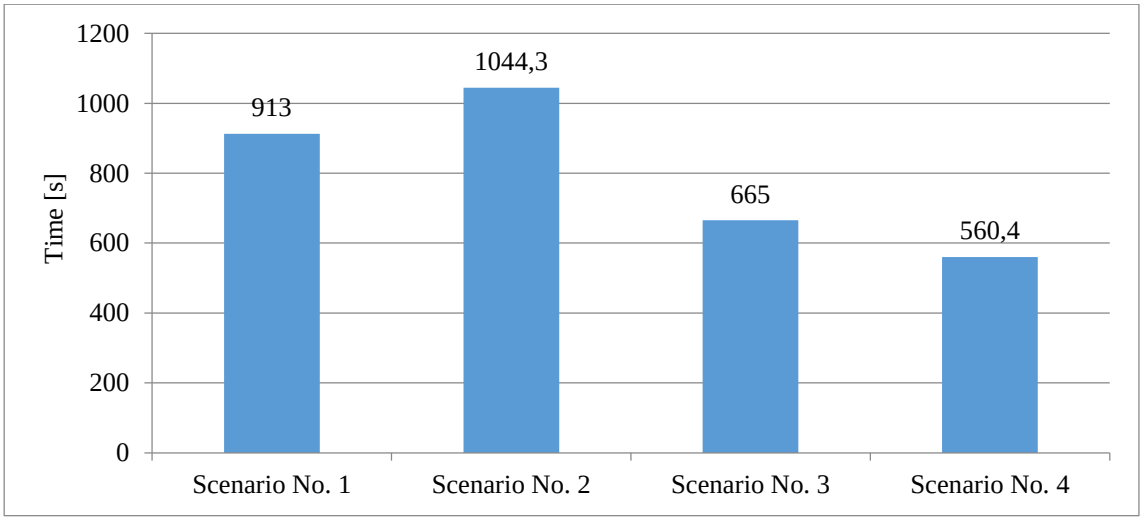



**Figure 14.** Evacuation of products - obtained times.

Source: Sopoćko, 2019.

The above graph (Figure 14) shows the times that were obtained during the simulation of property evacuation. In the case of the implementation of evacuation according to the variants where the forklifts worked in parallel inside and outside the warehouse, shorter evacuation times are obtained - this is confirmed by the simulation for Scenarios No. 1 and 4. In the situation where the forklifts working inside the warehouse were to directly evacuate the property outside, the evacuation time increased - as shown by the simulation for Scenarios No. 2 and 3. In the case of simulation No. 2, the evacuation time was 131.3 seconds greater, as in the case of simulation No. 3 - the obtained time increased by 104.6 seconds.

## 4. Discussion

Preparing for evacuation should be preceded by, among other things, organizing systems (Dahlke, Idczak, 2021):

- threat detection (internal (in-company) and external (off-site)),
- notification of hazards (or their level) requiring evacuation,
- analysis of the effectiveness of evacuation operations (preparation of effectiveness measures),
- design and implement changes to improve evacuation efficiency,
- evaluation of implemented improvement changes.

The last three activities mentioned above can be analyzed using simulation models that replicate actual evacuation conditions. These activities are intended to prevent losses and can be a supporting element (Mannan 2012):

- threat identification techniques,
- quantitative approach to threats,
- quantitative assessment of risks and their evaluation against risk criteria,
- reliability engineering techniques,
- principles of independence in critical evaluations and inspections,
- planning for emergencies,
- incident investigations along with a critical look at traditional practices or existing regulations, standards and codes if they seem outdated due to technological changes.

The results of the simulation modeling presented in Chapter 3, can be part of the aforementioned emergency response plan. An example of the structure of such a plan is presented in Figure 15.

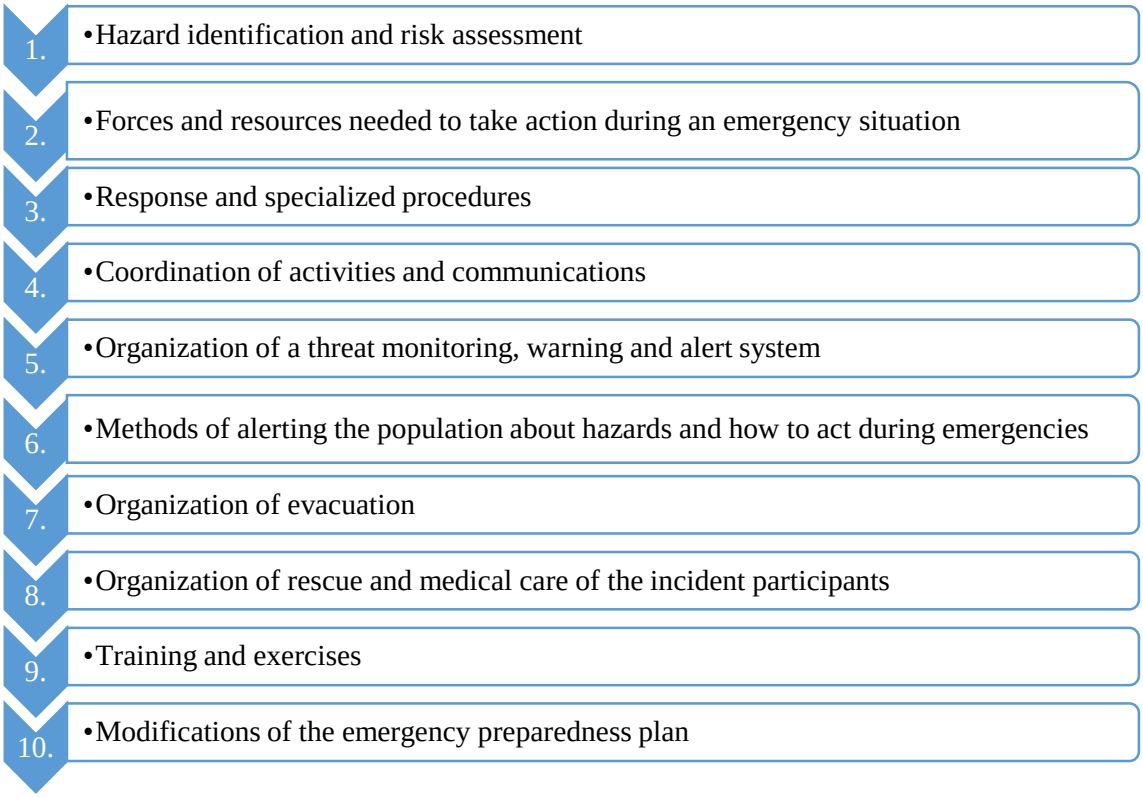



**Figure 15.** List of the main components of the emergency preparedness plan.

Source: Sopoćko, 2019 based on the Association of European Railways, 2001, pp. 1-67, and Dz.U. of 2007. No. 89, item 590.

The development of an emergency preparedness plan is a kind of strategy involving prevention and minimization of possible consequences. Undoubtedly, in order to facilitate the process of preparing such a document, you can use the evacuation simulation carried out earlier. Figure 16 shows what undertakings and annexes are required and should be included in such a plan. The red color indicates those functions that can be supported by evacuation simulation modeling. These include:

- identify appropriate human and equipment resources,
- designation of evacuation routes,
- determine the method of property evacuation, and also
- development of scenarios for trial evacuation.

| | |
|---|---|
| 1 | Hazard identification and risk assessment:<br>• identification of sources, types, and scale of hazards;<br>• risk assessment; |
| 2 | Forces and resources needed to take action during an emergency:<br>• identify the actions needed to remove the consequences of an incident;<br>• identify the resources needed to implement the actions;<br>• identify the entities and employees of the company that will be involved in the implementation of activities;<br>• identifying the relationships between the various entities;<br>• determine whether the human and equipment resources are sufficient to implement the activities; |
| 3 | Response and specialized procedures:<br>• definition of response and specialized procedures;<br>• determination of situations when the plan will be activated;<br>• determination when normal procedures are insufficient and specialized procedures are activated; |
| 4 | Coordination of activities and communications:<br>• determining the implementation of activities;<br>• designation of persons who are responsible for activating the plan, calling emergency services and coordinating activities until their arrival, and who will provide pre-medical first aid;<br>• designation of the communication point of people involved in the implementation of activities;<br>• determination the method of reporting the state of operations during an emergency; |
| 5 | Organization of the threat monitoring, warning and alert system:<br>• determining the way of hazard control;<br>• determining whether the available systems, devices and equipment are sufficient to detect hazards and alert on them;<br>• determining whether additional resources are needed for hazard monitoring, warning and alerting; |
| 6 | Methods of warning the population about hazards and procedures during their occurrence:<br>• determination how the population will be informed about hazards, designated persons responsible for launching and coordinating actions, and procedures during the emergence of hazards; |
| 7 | Organization of evacuation:<br>• determination of evacuation routes;<br>• determination of the method of evacuation of property and persons in the object;<br>• determining the assembly point for evacuees and property; |
| 8 | Organization of rescue:<br>• designation of communication point with emergency services;<br>• method of informing emergency services about important developments;<br>• ensuring the permeability of access routes for emergency services;<br>• designation of First Aid point;<br>• conclusion of mutual aid agreements; |
| 9 | Training and exercises:<br>• identify the type, scope and frequency of training;<br>• determining the recipients of training;<br>• determination of the frequency of trial exercises;<br>• development of incident scenarios for conducted trial exercises; |
| 10 | Modifications of the emergency preparedness plan:<br>• determine the method of actualizing the emergency preparedness plan;<br>• determine the circumstances when the plan will be updated; |

**Figure 16.** Activities and annexes of the emergency preparedness plan.

Source: Sopoćko, 2019 based on the Association of European Railways, 2001, pp. 1-67, and Dz.U. of 2007. No. 89, item 590.

Performing an evacuation simulation can also enable to propose the investigated enterprise, first of all, organizational and technical changes that can contribute to the shortest possible evacuation times during an emergency incident.

Unfortunately, the investigated enterprise does not have a developed emergency preparedness plan. It is therefore necessary to designate a team of people who will be responsible for developing and periodically updating this document. The content of the draft document should include, for example, the method of alerting about identified hazards, especially of threats requiring the evacuation of people and property. In addition to the issue of

evacuation of the people, the information relating to the evacuation of property from the warehouse should be included. In the research part, a simulation was performed based on the actual distribution of the assortment in the warehouse. By performing an assessment of the value of the assortment, we determined that the valuable products are located quite far from the gates through which property can be evacuated. Based on the results, some changes in the layout of products were suggested (Figure 17). It was recommended that the evacuation of property be carried out by forklifts operating inside and outside the warehouse. The obtained results clearly showed that this variant of operation is more favorable, since shorter evacuation times are obtained in each case considered. Performing simulation of evacuation may enable the company to receive an answer to the question about the sufficiency of available resources of equipment to implement such a process in the situation of a sudden and unexpected incident.

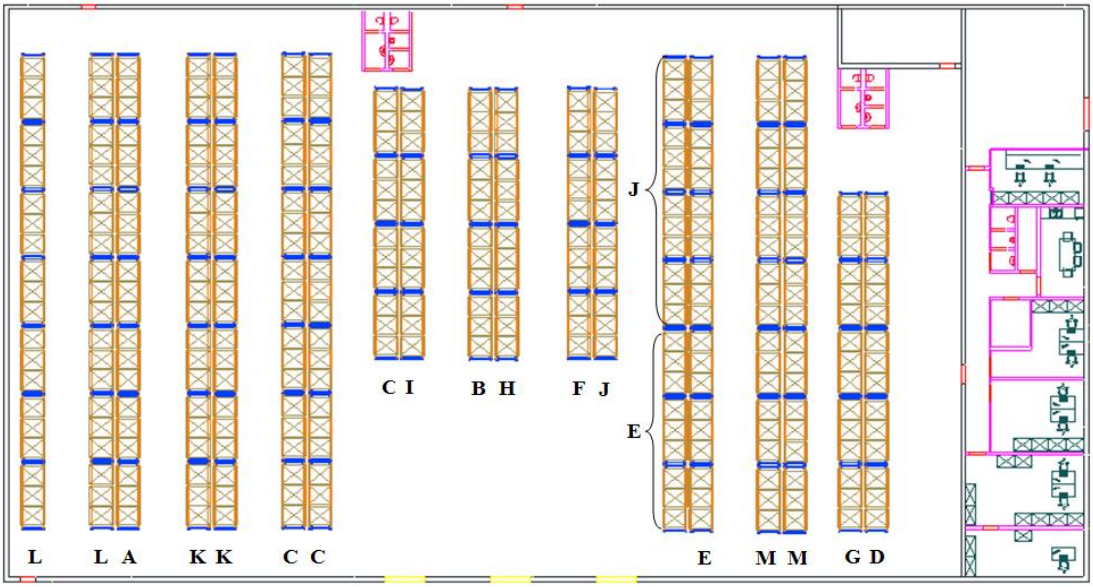



**Figure 17.** Proposal of assortment distribution correction.

Source: Sopoćko, 2019.

The team who is responsible for preparing and updating the emergency preparedness plan should determine the rules for conducting training and practical evacuation exercises. Conducting a trial evacuation is a requirement of the law, and its purpose is a practical verification of knowledge and, at the same time, raising awareness among facility users about the possible dangers and hazards that may occur. In addition, during this type of exercise, people acquire the skills to act (Chudy, 2016, p. 42). It is worthwhile to conduct a trial evacuation on the basis of a previously prepared scenario which is likely to occur. Before conducting such an exercise, the evacuation can be simulated in Pathfinder software to eliminate errors that may occur during the exercise, but it also allows to visualize how the exercise will be conducted. Performing an exercise allows to receive information about a plan's correct and assumed functionality, and what should be improved in the plan.

The last aspect to which attention should be given is training, which should be organized not only for newly hired employees, but also for those already employed. Each person should be trained in first aid and fire safety features present in the facility, but also in the contents of the emergency preparedness plan. In addition, every employee should be introduced to any changes in the plan by receiving update training.

## 5. Summary

The applicative conclusions presented in Chapter 4, provide an example of the implementation of simulation modeling in enterprise security management. This example can be viewed as a universal approach to decision support for planning of response to incidents requiring evacuation of products from the warehouse. In the research section, among a number of evacuation support tools, Pathfinder software was used to run a simulation for an example organizational unit. Before conducting the simulation, various types of evacuation scenarios were prepared. One of the most important steps in collecting data for the development of evacuation scenarios is the identification of hazards whose impact may, depending on the acceptable level, require evacuation. Both the scenarios and their mapping during simulation modeling require quantitative data (Drzewiecka-Dahlke, 2017), which can also be analyzed during trial evacuations, becoming measures of the effectiveness of evacuation conditions.

An emergency situation is an unplanned and sudden incident that cannot be predicted, but by implementing appropriate procedures it is possible to minimize its effects. During the occurrence of such a situation, it is important to ensure safe and efficient evacuation. Achieving this is possible by conducting systematic and periodic rehearsal exercises, through which the users of the facility will increase their awareness of the risks, but also as a result will be influenced on the final evacuation time.

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