

STORYBUILDER INFORMATION SHEETS: DEFINITIONS

Accidents Analysed

9142 reported investigated accidents of the Dutch Labour Inspectorate have been analysed. These accidents are distributed across 36 storybuilds (graphical structures in the software StoryBuilder).

The analysed accidents occurred between 1998 and end February 2004 except for 03.1 Contact with falling objects cranes, 03.2 Contact with falling objects not cranes, and 08.1 Contact with moving parts of machine, where only accidents between 2002 to 2003 were analysed.

Codings used in the analysis

A (activity at time of accident)

ABS (Absence from work)

BFM (Barrier Failure Mode)

1_BFM (Barrier failure mode 1 which is linked to 1_DS, 1_T)

BSM (Barrier Success Mode)

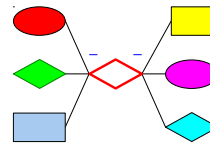
BSU (Barrier State Unknown)

BWT (Transfer to/from another bowtie)

CE (Centre event)

DDF (Dose Determining Factor)

DS (Delivery system failure)



ET (Equipment type - often using the ESAW¹ classification)

FOD (Final Outcome Death)

FOI (Final Outcome Probably Not Permanently Injured)

FOP (Final Outcome Probably Permanently Injured)

G (Group box - identifies a group of events)

HOSP (Whether hospitalised)

IF (Incidental factor)

INJP (Part of body injured - using ESAW classification)

INJT (Type of injury - using ESAW classification)

LCE Loss of control event)

PSB (Primary safety barrier)

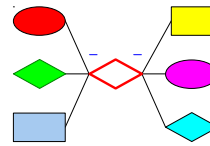
REG (Regulations)

SSB (Support safety barrier)

T (Barrier task)

1_T (Barrier task which is linked to 1_DS, 1_BFM)

¹ ESAW - European Statistics on Accidents at Work methodology 2001, Eurostat



Definitions

Final outcomes

Death, permanent injury, recoverable injury and unknown.

FOD - DEATH The result of an occupational accident resulting in death within one year after the accident: the IP will not return to work and dies within one year.

FOP - PERMANENTLY INJURED BODY-PART: An injured body-part which, according to reasonable judgement, will remain longer than two years after its origin . Two situations can be distinguished: the IP will only partly return to work after recuperation or the IP will never return to work (percentage of disability is 100%).

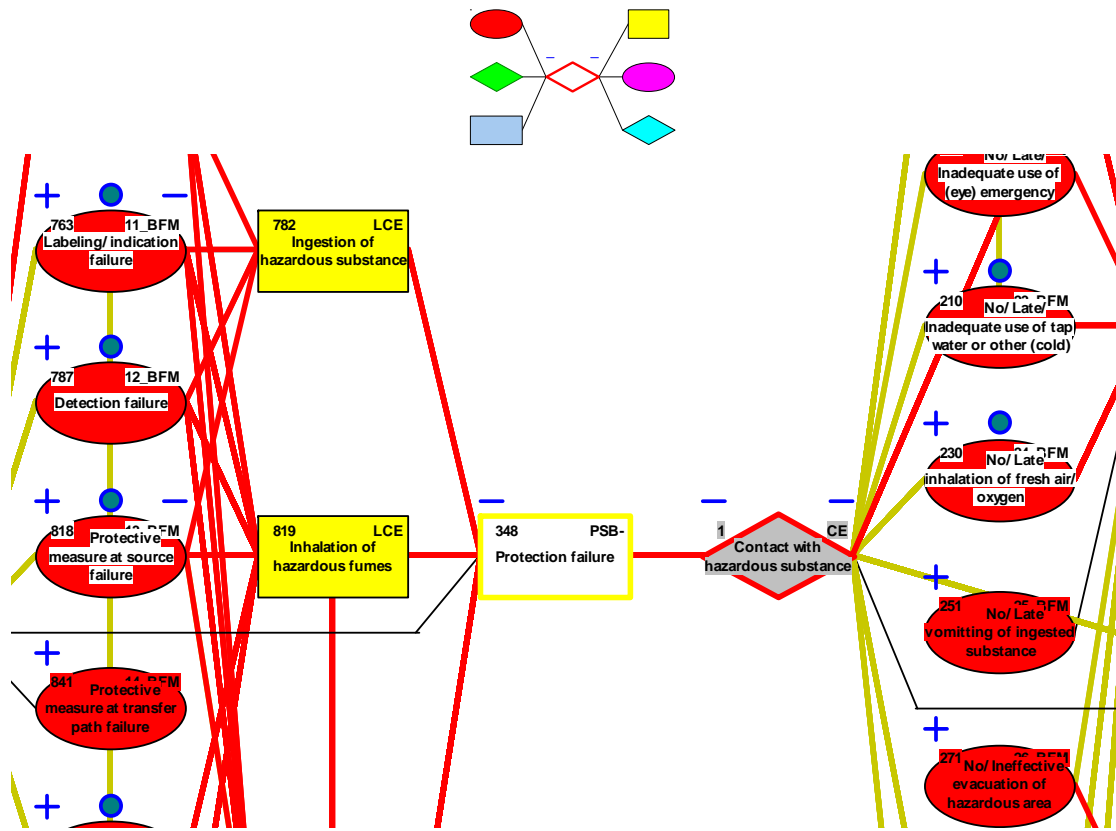
FOI - NON-PERMANENTLY INJURED BODY-PART: An injured body-part which will totally recover after recuperation or which regains its original function completely. Result: the IP (injured person) can return to work after the period of recuperation.

UNKNOWN: If there was no information available concerning the final result of the injury then the category unknown was used

Together with general information about type/severity of injury and corresponding final result of the injury (in terms of permanent/non-permanent/death) the recorded injury information was used to estimate the final result of the injury.

CENTRE EVENT FREQUENCIES

A storybuild is a graphical structure representing failure events in accidents. The centre event of this structure is the event in the structure through which all scenarios (accident paths) pass and which represents the release of the hazard agent e.g. in the figure the centre event is Contact with Hazardous Substance.



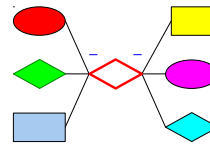
• Figure 1 Section of a storybuild showing centre event

Barrier Failure Mode (BFM)

A barrier is a physical entity (object, state, or condition) that acts as an obstacle in an accident path.

Typical Barrier Functions are:

- o Prevent presence, build-up, or release of the hazardous agent/ energy
- o Separates hazardous agent/ energy in space (safe distance) or time (safe moment)
- o Prevents the undesired transmission of energy/ hazardous agents



- o Prevents incompatibility of materials
- o Prevents unsafe process conditions (pertains to sequence, temperature, pressure, composition)
- o Prevents unsafe physical conditions (pertains to structural integrity, strength, stability)

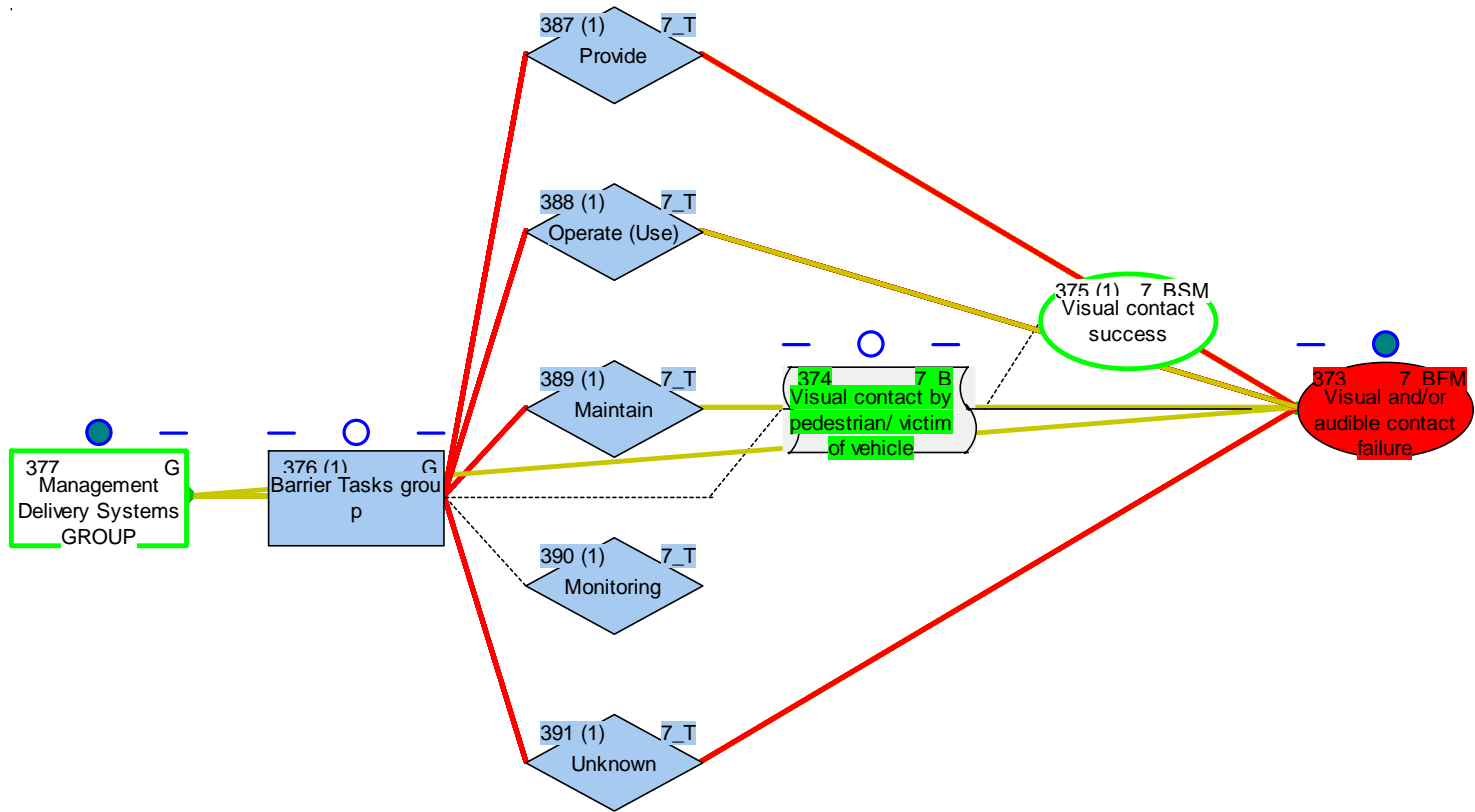
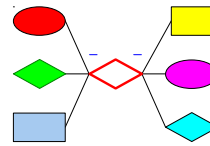
A barrier failure mode (BFM) is one way in which the barrier failed in an accident scenario e.g. a structure not being strong enough for the exerted load

Barrier task failures (PUMMs)

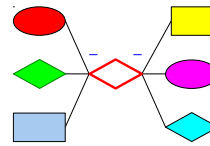
The tasks, particularly the use and maintain tasks, are operable on a lower level in the overall system: i.e. at the barrier level where operators/workers and maintenance fitters are working. The provide task is, on the other hand often a management task.

The tasks fail as follows:

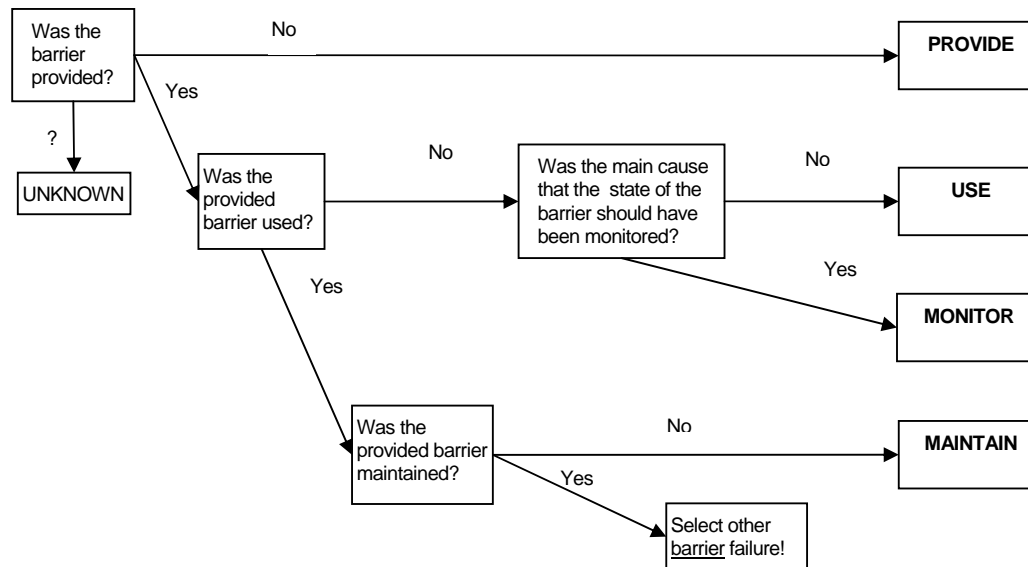
- o **Provide-[barrier] failure**
= It does not exist, has not been well designed, or it is not provided and / or sufficiently/easily available when you want to use it. Such a barrier can be hardware or a specific method (sequence, composition, or other parameter(s) with safe limits).
- o **Use-[barrier] failure**
= the correct barrier is provided, but the way in which the provided barrier is used is incorrect, it is only partially used, or it is not used at all. A 'use' failure is also the case, when somebody chooses to use a barrier other than the correct one, despite the correct one being available.
- o **Maintain-[barrier] failure**
= the barrier is not kept available according to its designed function; i.e. in an adequate state. This does not only cover the maintenance aspect but also the management of change aspect of a barrier, i.e. a barrier is modified without ensuring that it maintains its barrier function.
- o **Monitor-[barrier] failure**
= the barrier condition is not checked/ measured/observed/inspected. This task relates directly to the state of the barrier, or to the supervision of the use of the barrier.

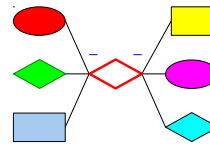


• Figure 2 Part of storybuild showing the "PUMM" tasks which support a barrier



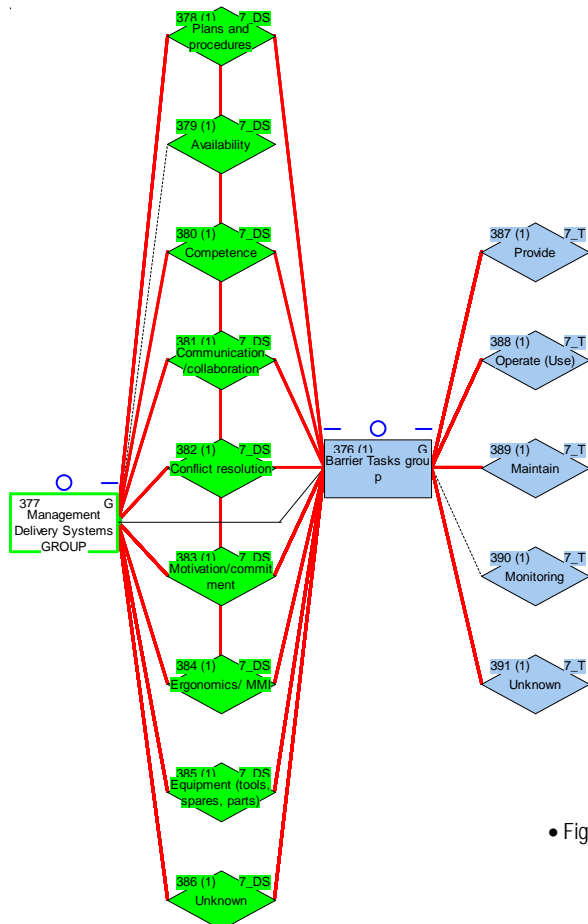
The most relevant failing task per barrier is identified by applying the following scheme:



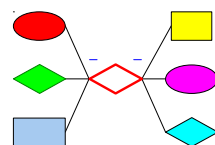


Management delivery system failures (DS)

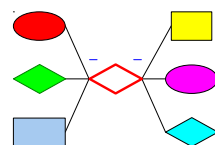
The delivery systems are modelled to show whether the criteria and resources failed to have been delivered to the technical system through the task.



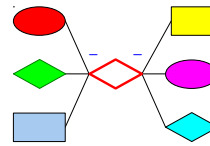
• Figure 3 Example of delivery systems connected to barrier tasks



Delivery System (What's delivered)	Description
Plans & procedures [NL: Plannen & Procedures]	<p>Procedures refer to specific performance criteria which specify in detail, usually in written form, a formalised 'normative' behaviour or method for carrying out tasks, such as: checklist, task list, action steps, plan, instruction manual, fault-finding heuristic, form to be completed, etc.</p> <p>Plans refer to explicit planning of activities in time: either how frequently tasks should be done, or when and by whom they will be done within a particular time period (month, shutdown period, etc.). It includes: maintenance regime, maintenance scheduling (including shutdown planning), and testing and inspection activities. This delivery system also refers to rules, permits, programs and risk assessments.</p>
Availability [NL: Beschikbaarheid (van mankracht)]	<p>Availability refers to allocating the necessary time (or numbers) of competent and suitable (incl. anthropometrics and biomechanics) people to the tasks to be carried out. It emphasizes time-criticality, i.e. people available at the moment (or within the time frame) when the tasks should be carried out.</p> <p>This delivery system includes the availability of staff for repair work on critical equipment outside normal work hours, incl. coverage for absence and holidays.</p>
Competence [NL: Deskundigheid]	<p>Competence refers to the knowledge, skills and abilities of the people selected for the execution of tasks. It also covers the selection and training function of a company to deliver sufficient staff for overall manpower planning.</p> <p>This delivery system also refers to 'right person for the job', i.e. with the proper knowledge to provide, use, maintain or monitor the barrier effectively.</p>
Communication, collaboration [NL: Communicatie, samenwerking]	<p>Communication/ Collaboration refers to internal communication and coordination. Internal communications are those communications which occur implicitly or explicitly, within any primary business activity, i.e. within one task or activity in order to ensure that the tasks are coordinated and carried out according to relevant criteria.</p> <p>This delivery system also refers to task instructions and communication channels and means (such as meetings, logs, phones, radio).</p> <p>Note: this delivery system is only relevant if the activity is carried out by more than one person (or group), who have to coordinate or plan joint activities.</p>
Motivation/ Commitment [NL: Motivatie/ Instelling]	<p>Motivation/ Commitment refers to incentives and motivation with which people have to carry out their tasks and activities, i.e. with suitable care and alertness and according to the appropriate safety criteria and procedures specified for the activities by the organisation.</p> <p>This delivery system also includes the aspect of alertness, care & attention, concern for safety of self and others, risk avoidance and willingness to learn & improve.</p> <p>Note</p> <ul style="list-style-type: none"> - This delivery system is fairly closely related to Conflict resolution, in that it deals with the incentives of individuals carrying out tasks not to choose other criteria above safety, such as ease of working, time saving, social approval, etc.



Delivery System (What's delivered)	Description
	<ul style="list-style-type: none"> - Organizational aspects of conflicts are covered by Conflict resolution. - More personal aspects, such as violation of procedures, are covered by Motivation/ Commitment.
Conflict resolution [NL: Prioriteitstelling (het stellen van de juiste prioriteiten)]	Conflict resolution deals with conflicts between safety and other goals within the performance of tasks. It deals with the mechanisms (such as supervision, monitoring, procedures, learning, group discussion) by which potential and actual conflicts between safety and other criteria in the allocation and use of personnel, hardware and other resources, are recognised, avoided or resolved. Note: <ul style="list-style-type: none"> - This delivery system is closely related to Motivation/ Commitment. - Issues of violations within tasks at an individual level are covered by Motivation/ Commitment. - Conflict resolution covers the organisational mechanisms for resolving conflicts across tasks, between people at operational level and at management level.
Ergonomics [NL: Ergonomie]	Ergonomics/ MMI deals with the fit between the man and the task. It refers to the ergonomics of all equipment used/ operated by operations, inspection or maintenance to provide, use, maintain or monitor the barriers. This delivery system covers both the appropriateness of the interface for the task and the user-friendliness to carry out tasks. It includes: <ul style="list-style-type: none"> - appropriate equipment, tools and software, - robust/ appropriate/ good interface and labelling, and - operability and maintainability. Ergonomics/ MMI also covers: <ul style="list-style-type: none"> - design and layout of control rooms and manually operated equipment, - location and design of inspection and test facilities, - the maintenance-friendliness of equipment, and - ergonomics of the tools used to maintain it. Note: MMI stands for Man - Machine Interface
Equipment (tools, spares, parts) [NL: Equipement (gereedschap, materieel, (reserve) onderdelen)]	Equipment refers to the hardware needed for provision, maintenance and monitoring of barriers. This delivery system covers both the correctness of the equipment for their use (compatibility, suitability, quality), and the availability of equipment where and when needed to carry out the activities. It includes: spares & parts (incl. those needed for maintenance) and adequate & correct stocks.



Delivery failures in relation to tasks

Failed to deliver good plans, procedures, rules or criteria for how and when something should be done in relation to the barrier. This could be a delivery failure:

- Through the “provide” task: no plans or procedures to provide the barrier.
- Or through the “use” task : the barrier has not been used because of a plans & procedures delivery failure (e.g. user followed the wrong procedure, or the procedures were delivered but were misinterpreted).
- Or through the “maintain” task: no procedures/ plans to maintain the barrier
- Or through “monitor” task: no procedures to monitor the barrier state.

Failed to deliver communication/coordination about how/what/when. This could be a delivery failure:

- through the “provide” task: no communication and/or coordination among the different people with respect to providing the barrier: i.e. crucial information not communicated. (e.g. wrong information given to provider)
- or through the “use” task: no communication/ coordination among the different people delivered with respect to providing the barrier, but not with respect to using the barrier.
- or through the “maintain” task: no communication and/or coordination among the different people with respect to maintaining/ the proper maintenance of the barrier.
- or through the “monitor” task: no communication and/or coordination provided among the different people with respect to the proper monitoring of the barrier state.

Failed to deliver sufficient people to be available. This could be a delivery failure:

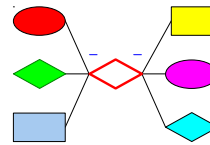
- through the “provide” task: not sufficient people available (at all) to provide the barrier.
- or through the “use” task: insufficient people available to use the barrier (this makes sense if the task requires more than one person in order to do the job properly, or requires one person present and there was nobody).
- or through the “maintain” task: not sufficient people available to properly maintain the barrier.
- or through the “monitor” task: not sufficient people available to enable proper monitoring of the barrier state.

Failed to deliver appropriate competence. This could be a delivery failure:

- through the “provide” task: insufficient competence to provide the barrier. This could be a lack of competence in the process of selecting people, or a lack of skill in routine use, or knowledge of how and when to use a barrier in unusual or unexpected circumstances.
- or through the “use” task: competence provided but not used.
- or through the “maintain” task: insufficient competence to properly maintain the barrier.
- or through the “monitor” task system: insufficient competence provided to enable proper monitoring of the barrier state.

Failed to deliver the appropriate equipment/support/tools spares when these are required for the barrier (job). This could be a delivery failure:

- through the “provide” task: no adequate equipment to provide the barrier: e.g. wrong or no equipment (or spares) in stock.



- or through the “use” task: no adequate tools or parts delivered or present to use the barrier: e.g. wrong parts selected/ used.
- or through to the “maintain” task: no spares or parts or appropriate apparatus to properly maintain the barrier.
- or through to the “monitor” task: no equipment provided to enable proper monitoring of the barrier state.

Failed to deliver motivation/incentives for the desired behaviour. This could be a delivery failure:

- through to the “provide” task: no motivation (of management) to provide the barrier.
- or through the “use” task: no motivation (of the user) to use the barrier, e.g. to choose the correct barrier, or to accept the psychological or physical costs of using barriers which demand extra time, effort or discomfort.
- or through to the “maintain” task: no motivation (of management) to maintain the barrier, and/or no incentives to carry out maintenance fully or adequately
- or through the “monitor” task: no motivation (of and/or from management) to monitor the barrier state.

Failed to deliver criteria for conflict resolution with production/time/ pressures. This could be a delivery failure:

- through the “provide-barrier” system: no clear (or other than) safety priorities in place (set by management) to provide the barrier.
- or through the “use” task: the user has other priorities than using the barrier (the safe way).
- or through the “maintain” task: no clear criteria or no priority to maintain the barrier (or other priorities than for safety)
- or through the “monitor” task: no priority to monitor the barrier state.

Failed to deliver ergonomic support for the job (e.g. non slip shoes, right lighting, protective equipment that fits.... i.e. failed to fit the task to the man). This could be a delivery failure:

- through the “provide” task: the ergonomical aspect of the design is such, that the barrier is not provided in a specific situation.
- or through the “use” task: the ergonomics of the equipment, tools or auxiliary equipment is such, that the desired behavior/ proper use of the barrier is not sufficiently enforced.
- or through the “maintain” task: the design did not take into account the (ergonomics of) maintenance of the barrier.
- or through the “monitor” task: the design did not take into account the ergonomic aspect of properly monitoring the barrier state.

Don't know, then UNKNOWN.