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Risk assessment for sports and other recreational facilities and equipment

WD stage 20.20

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Foreword

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 83, *Sports and other recreational facilities and equipment*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

An ISO task group has determined a need for a system of identifying hazards and assessing risks related to sport and recreation for all ages and abilities. In many jurisdictions there is a requirement for the designer, builder, owner/operator, including inspectors and maintainers of a sport and other recreational facilities and equipment, to carry out a risk/benefit assessment and in some cases to record it.

The International Organization for Standardization has already provided Standards on risk assessment and risk management for occupational health and safety (ISO 31000:2009, ISO 31010:2009, and ISO 45001:2018). These Standards were written with the intention of preventing work-related injury and ill-health via the elimination of hazards and the minimization of Occupational Health and Safety (OH&S) risks by taking effective preventive and protective measures. Were the sport and recreation sector the same there would be no need for an additional Standard. The sectors are not the same and face different challenges. There is an expectation in sport and recreation activities that the user is making an implicit trade-off between the benefits of the activity and the inherent risks of the activity.

The terms “sports” and “recreation” describe diverse activities and the necessary equipment for all ages and abilities. For example, camping, hockey, high ropes and challenge course equipment, martial arts, games with rules such as football (soccer), kite boarding, summer tobogganing, play spaces, etcetera.

It is recognized that sports and recreation involves numerous stakeholders including designers, installers, owner/operators, maintainers, inspectors of sports and recreation equipment and facilities, and any park rangers, play workers or rangers or activity leaders who may be present at these venues.

Due to the variable interests of the different stakeholders a single system of hazard identification and risk assessment for the sport and recreation sector is not feasible. What can be achieved, however, is to identify principles and offer assistance in selecting appropriate techniques.

A key issue identified by the working group is the differentiation of sports and recreation activities from a work activity. Sports and recreation activities are designed for the public good, and therefore public interests are paramount. The public good can include social, physical, psychological, and health for the welfare and benefit of the participant and society as a whole. Participation in sport and recreation involves exposure to risk which is not necessarily a bad thing and can be of benefit to the public good. The consequence of a risk deficient culture instills that the world is something to be frightened of and greatly limits the development of human competency. For example, in adventure sports exposure to risk is what provides part of the enjoyment. Even in the case of children's play provision, it is now widely recognized that children will seek risky situations. Exposure to some risk is essential human development.

It is common to conduct a benefit/risk analysis that explicitly brings together the consideration of benefits as well as the risks of sport and recreation to a single evaluation. This immediately separates sport and recreation from the world of occupational health and safety where the goal, as noted above, is generally seen as one of eliminating or minimizing risk.

Within sport and recreation, there are many different goals of which safety from injury is but one. Using an alternative approach to risk assessment recognizes the need for making trade-offs in achieving a balance that maximizes the overall social utility and public good. These are not the only considerations, though they are important ones. Whether provided on a commercial, not-for-profit or charitable basis, sport and recreation activities involve an accepted, inherent element of risk and challenge. Taking risks brings rewards but also brings dangers.

The range of stakeholders involved in sport and recreation is so diverse, different types of benefit/risk assessment are needed. Generally, there are three types of assessments that can be used: the generic risk assessment, the site-specific risk assessment and the dynamic risk assessment. This Standard will

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help providers of products and operators of facilities to better understand the risks associated with their products, activities and facilities, and to help evaluate, implement and document a suitable benefit/risk analysis. For example, a generic risk assessment technique could be used to analyze the risks related to skis, while a site-specific risk assessment could be used by the owner/operator to evaluate the ski hill, and the skier and the ski instructor would be dynamically assessing the risk during the skiing activity.

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Risk assessment for sports and other recreational facilities and equipment

1 Scope

The hazard identification and risk assessment approach provides significant advantages to the development of new play, recreation and sport environments when used by designers, manufacturers, installers, owner/operators and maintainers to assess the risks that could lead to harm to persons. This is particularly important when new materials or spaces are introduced that do not follow the prescriptive requirements of published Standards. Assessment of the inherent risk in a design, and the expected residual risk remaining following risk mitigation are the contributions and outputs of a written risk assessment.

In addition, it is important to assess the benefits of the activity in balance with the risks that could lead to harm.

This International Standard provides methods regarding benefits assessment, hazard identification and risk assessment, including example injury thresholds. See Annex X and XX.

The purpose of this ISO is not to be prescriptive but to give general guidance on the approach to assessing risk. There are multiple methods of risk assessment to choose from (see ISO 31010:2018), but some are more suited to the design stage and others to the operational stage (see Figure 1 (was 4)). Also, there have been developments in understanding of risk assessment since ISO31010 was published.

2 Normative references *(mandatory)*

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC Guide 50:2014, *Safety aspects — Guidelines for child safety in standards and other specifications*

ISO/IEC Guide 51:2014, *Safety aspects — Guidelines for their inclusion in standards*

ISO Guide 73:2009, *Risk management — Vocabulary*

ISO/TR 20183:2015, *Sports and other recreational facilities and equipment -- Injury and safety definitions and thresholds -- Guidelines for their inclusion in standards*

IEC 31010:2019, *Risk management — Risk assessment techniques*

3 Terms and definitions *(mandatory)*

3.1
activity leader
text of the definition

3.2
benefit
helpful or good effect, or something intended to help [SOURCE: ISO 16439:2014, 3.7]

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Comment [1]: Still open for debate following the Tokyo meeting.

Doug Nix 2019-10-29 15:08
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Deleted: ISO 21101:2014, *Adventure tourism — Safety management systems — Requirements* ... [1]

3.3
competence
ability to apply knowledge and skills to achieve intended results [SOURCE: ISO/IWA 26:2017(en), 3.9]

a demonstrated ability to apply OHS knowledge and skills to the hazard identification and risk assessment processes. [SOURCE: CSA Z1002]

3.4 competent person

person who has acquired through training, qualifications or experience, or a combination of these, the knowledge and skills enabling that person to perform a specified task [SOURCE: ISO 17842-1:2015(en), 3.6]

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Deleted: a person who is knowledgeable about the risk assessment process and has a demonstrated ability to apply the process by reason of education, training, experience, or a combination thereof. [SOURCE: CSA Z1002] ... [2]

3.5 competent body

person or corporate body who, by combination of appropriate qualifications, training, experience and resources, is able to make objective judgements on the subject [SOURCE: ISO 22991:2004(en), 3.4]

3.6 safe the state of being protected from recognized hazards that are likely to cause harm [SOURCE: unk]

capacity to be used at an acceptable level of risk of harm [SOURCE: ISO 19867-1:2018(en), 3.53]

condition that renders the probability of an unwanted event below an agreed limit [SOURCE: ISO 26871:2012(en), 3.1.33]

property of an item and its environment that limits its potential for damage to an acceptable risk [SOURCE: ISO 14620-2:2011(en), 3.28]

3.7 safety freedom from risk which is not tolerable [SOURCE: Guide 50:2014, 3.14]

Note 1 to entry: Safety is achieved by reducing risk to a tolerable level. [SOURCE: ISO/TR 20183, 2.2]

Note 2 to entry: There is no complete absence of risk. In turn there is no product or system that is without some risk, which must be reduced to a tolerable risk. [SOURCE: : ISO/TR 20183, 2.2]

3.8 risk combination of the probability of occurrence of harm and the severity of that harm

Note to entry: The probability of occurrence includes the exposure to a hazardous situation, the occurrence of a hazardous event, and the possibility to limit the harm

[SOURCE: ISO 12100:2010, 3.12]

risk criteria

The terms of reference by which the significance of risk is assessed.

Note 1 to entry: Risk criteria can include associated cost and benefits, legal and statutory requirements, socio-economic and environmental aspects, the concerns of stakeholders, priorities and other inputs to the assessment.

[SOURCE: ISO Guide 73:2002, definition 3.1.6]

3.9 harm injury or damage to the health of people, or damage to property or the environment [SOURCE: ISO/IEC Guide 51:2014, 3.1]

Note: injury is a type of harm that applies to people and in relation to hazardous situations involving

267 people, injury and harm are often used interchangeably [SOURCE: unk]

268 **3.10 hazard** potential source of harm (3.9)

269 [SOURCE: ISO Guide 51:2014, 3.2]

270 **3.11 hazardous event**

271 event that can cause harm (3.9)

272 [SOURCE: ISO Guide 51:2014, 3.3]

273 **3.13 hazardous situation**

274 circumstance in which people, property or the environment is/are exposed to one or more hazards
275 (3.10)

276 [SOURCE: ISO Guide 51:2014, 3.4]

277 **3.14 tolerable risk or acceptable risk**

278 risk which is acceptable in a given context based on the current values of society [SOURCE: ISO Guide
279 51:2014, 3.15]

280 Risk reduction measure or protective measure - any action or means of eliminating hazards or reducing
281 risk [SOURCE: unk, maybe ISO 31000 or 31010?]

282 Note to entry: Risk reduction measures or protective measure could include, but are not limited to,
283 eliminating hazards, guarding against hazards, use of protective devices, and reducing the likelihood of
284 hazardous events. [SOURCE: unk]

285 **3.15**

286 **residual risk**

287 remaining risk after risk reduction measures (protective measures) have been taken [SOURCE: ISO
288 Guide 51:2014, 3.8, modified]

289 Note to entry: Following risk reduction measures, the residual risk should be less than tolerable risk,
290 thus providing safety. [SOURCE: : ISO/TR 20183, 2.1]

291 **3.16**

292 **risk analysis**

293 systematic use of available information to identify hazards and to estimate risk

294 **3.17**

295 **risk evaluation**

296 procedure based on the risk analysis to determine whether a tolerable risk has been achieved

297

3.18

risk assessment

overall process comprising a risk analysis and risk evaluation

Note to entry: Degree of exposure to risk, comprised of the potential severity of the harm and the probability of that harm occurring. In determining the probability of occurrence of harm, the exposure of a user to a hazardous situation, the possibility of a hazardous event, and the potential means of limiting the harm should all be considered."

3.19

intended use

use of a product or system in accordance with the information provided by the supplier

3.20

reasonably foreseeable misuse

use of a product or system in a manner not intended by the supplier, where that manner of use could be anticipated based on predictable human behaviour

Note 1 to entry: Also referred to as 'foreseeable misuse.

Note 2 to entry: In evaluating readily predictable human behaviour, all relevant demographics should be considered, including, but not limited to, elderly, children, and persons with disabilities.

Note 3 to entry: In the context of consumer safety, 'reasonably foreseeable use' is often used to encompass both 'intended use' and "reasonably foreseeable misuse".

3.21

user

the ultimate user of a product or service

Note to entry: For a child under the age of consent the user may be a parent, legal guardian or qualified caregiver.

3.22

inspection

act of careful examination or scrutiny and identifying hazards, and hazardous situations and evaluation of compliance with regulations, codes and standards.

Note to entry: Inspection should include, but not be limited to, consideration of hazards that can emerge during or as a result of intended operation, reasonably foreseeable misuse, vandalism, aging of the product/environment, and weather conditions.

3.23

manufacturer

the party responsible for the design or fabrication of a portion or all of a product intended for a consumer

3.24

installer / assembler

the party responsible for assembly and or installation of a product to its final configuration intended by the manufacture and destined for use by a consumer.

Note to entry: The installer makes the product ready to use, brings it into the market and has the same responsibility as the manufacturer, they may even combine several products to a system and acts on behalf of the manufacturer

3.25

operator

the person(s) or organization(s) who allow a product to be used

Note to entry: An operator may implement an active role as a designated supervisor during use.

3.26

protective device

an apparatus, such as a guard, that blocks, shields, or otherwise prevents access to a hazard or reduces the degree of harm that can be caused by a hazard

Note to entry: A protective device could be a technical device such as a railing

3.27

graduated challenge

an event in sport and recreation, confronting the users with activities to test their physical, mental, emotional\or social skills and to achieve a given, intended outcome.

Note to entry: Based on the ability of the user, there could be circumstances where a user is presented with hazards that shall be eliminated or reduced for the intended user group and unintended users should be warned away. The user group can be identified by age or ability within the appropriate standard

3.28

user information

instructions, warning labels, or other written documentation provided by the manufacturer regarding use and maintenance requirements for the product, as well as issues of potential residual risk that could be related to aging of the product or skill of the user.

Note 1 to entry: This documentation could be provided by the manufacturer prior to purchase,

installation, or acquisition of the product by the owner and/or operator. The documentation should be available to the user prior to initial use.

Note 2 to entry: Information should be provided in a clear and understandable language and where provided as pictogram or signage this must be clearly visible and understandable by the user.

3.29

warning

notice or communication to indicate a potentially hazardous situation that if not avoided may result in risk

Note to entry: Warning can be a specific key word used in safety labels and will have specific requirements with certain standards and jurisdictions. The same would apply to the use of Danger, Caution and Notice.

3.30

as low as reasonably practicable (ALARP)

determine the level of residual risk, after steps of hazard reduction have taken place.

Note 1 to entry: The main tests that are applied in regulating industrial risks are very similar to those applied in day to day life. They involve determining:

- whether a given risk is so great or the outcome so unacceptable that it must be refused altogether; or
- whether the risk is, or has been made, so small that no further precaution is necessary; or
- if a risk falls between these two states, that it has been reduced to the lowest level practicable, bearing in mind the benefits flowing from its acceptance and taking into account the costs of any further reduction. The injunction laid down in safety law is that any risk must be reduced so far as reasonably practicable, or to a level which is 'as low as reasonably practicable'

Note 2 to entry: For the risk to be ALARP it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained.

Note 3 to entry: The ALARP principle arises from the fact that infinite time, effort and money could be spent on the attempt of reducing a risk to zero. It should be understood as simply a quantitative measure of benefit against detriment. It is more a best practice of judgement of the balance of risk and societal benefit.

3.31

life-threatening injury

an injury to any part of the human body which is severe or resulting in permanent impairment, that received an Abbreviated Injury Scale (AIS) score of 4 (severe with survival probable) or greater

3.32

debilitating injury

an injury that diminishes or weakens the human body and has a legacy of greater than 1 month and that

401 could receive an Abbreviated Injury Scale (AIS) score of 3 (serious, but not life-threatening)

402 Note to entry: Debilitating injuries would include requiring surgery, concussions that require removal
403 from play to medical attention.

404 **3.33**

405 **serious injury**

406 an acute physical injury requiring medical or surgical treatment or under the supervision of a qualified
407 doctor or nurse, provided in a hospital or clinic and includes injuries such as burns, factures,
408 lacerations, internal injury, injury to organ, concussion, internal bleeding, etc. that could receive an
409 Abbreviated Injury Scale (AIS) score of 3 (serious, but not life-threatening). All evaluations have to be
410 considered in the light of the age of the user.

411 **3.34**

412 **age appropriate**

413 when selecting a product or equipment, it is important to know the age range of the persons, especially
414 children, who will use the product or equipment, as they will have various levels of skill, size, abilities
415 and development

416 Note to entry: A rough scale or age grouping may be 0-2, 2-5, 5-12, 12-14, 14-19 and may be governed
417 nationally according to structure of schooling.

418 **3.35 Abbreviated Injury Scale (AIS)**

419 a numerical rating for quantifying the severity of injury to a human based on body region, anatomic
420 structure, level of injury and injury severity that must be used in the scope of standards intended for
421 safety or injury prevention. The range of severity is from 1-9.

422 **Table 1 — Abbreviated Injury Scale (AIS)**

Injury Severity	Abbreviated Injury Score
Minor injury	1
Moderate injury	2
Serious, but not life-threatening	3
Severe, potentially life-threatening, but survival likely	4
Critical with uncertain survival	5
Un-survivable injury (maximum possible)	6
Severity unknown	9

423

424 The AIS system also considers

425 • different parts of the body: 1 head, 2 face, 3 neck, 4 thorax, 5 abdomen, 6 spine, 7 upper
426 extremities, 8 lower extremity, 9 unspecified;

427 • the type of anatomic structure: 1 whole area, 2 vessels, 3 nerves, 4 organs [including muscles

and ligaments], 5 skeletal [including joints], 6 loss of consciousness;

- head only or the entire body.

3.36

inherently safe design

measures taken to eliminate hazards (3.2) and/or to reduce risks (3.9) by changing the design or operating characteristics of the product or system

3.37

risk reduction measure

protective measure, action or means to eliminate hazards (3.2) or reduce risks (3.9)

EXAMPLE Inherently safe design (3.5); protective devices; personal protective equipment; information for use and installation; organization of work; training; application of equipment; supervision.

3.38

source

an item or activity having a potential for a consequence

3.39

surface

A point of contact between the user and an element in play, recreation or sport. The properties of the element could create a hazardous situation based on its composition and the nature of the potential harm.

Note 1 to entry: A surface could be one that the user is in regular contact and be the potential for a hazardous situation such as contain sharp points or edges, alternatively could through lack of friction cause the user to loose contact with the surface unexpectedly.

Note 2 to entry: A surface could be a point of contact that a user might fall onto, and resulting in an injury. This could also be a point of contact within the play, sport and recreation facility or environment.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Benefit/risk assessment process flow

4.1 General

The establishment of the context shall be the first task performed when conducting a benefit/risk analysis.

4.1.1 Context

Figure 1 graphically describes the relationship between the three different approaches to risk assessment is made. The relationship between the methods exists in the overlapping areas in Figure 1.

Figure 1 illustrates how different styles of risk assessment apply at different stages of a product / facilities lifecycle. At the design stage what is mainly required is generic risk assessment. At the site location benefit-risk assessment is important. At the activity leader stage dynamic risk assessment is most important.

Note: It is not implied that, e.g., designers will only use generic risk assessment. Obviously, they too need to be aware of the benefits of their designs. Likewise, activity leaders need to have some awareness of product design issues and which products are fit for the intended purpose.

Area 1 - Dynamic and generic. (Further text to be developed. Suggestions welcome.)

Area 2 - Generic and Site Specific (Further text to be developed. Suggestions welcome.)

Area 3 - Dynamic and Site Specific (Further text to be developed. Suggestions welcome.)

Area 4 - All methods (Further text to be developed. Suggestions welcome.)

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Deleted: Three broad contexts are recognized: product and facility designers, site managers, and activity leaders. According to which of these contexts you inhabit, you will prefer a different style of risk assessment. In general, for product and facility designers, some form of product risk assessment would be appropriate, while for site operators, some form of benefit/risk assessment would be preferable, and for activity leaders, dynamic risk assessment is preferred. ... [3]

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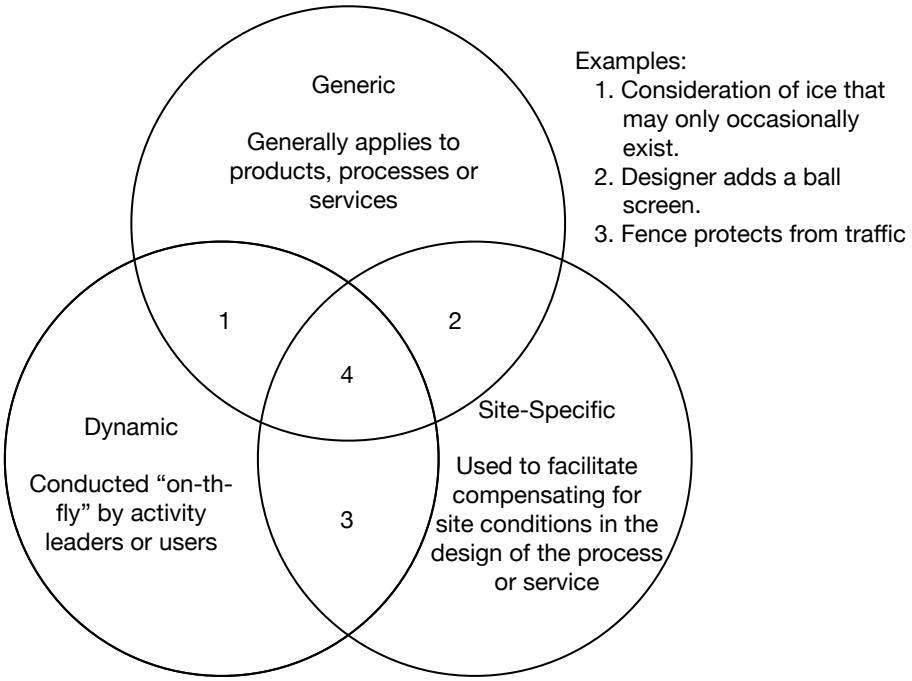

Figure 1 - Interrelationship of generic, site-specific, and dynamic risk assessments

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Comment [2]: Redrawn to equalize the size of the circles as discussed in Tokyo. This diagram was Fig. 4.

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4.1.2 Process

Every benefit/risk analysis is different and the context of each risk plays an important part in the assessment for the equipment risk, site-specific risk or the dynamic risk.

Each benefit/risk analysis shall take into consideration both the benefits (opportunities) and the hazards for that specific risk.

The context of the risk can and will affect future decisions and quantification (should a quantification be performed). For example if the user is new to a particular sport or recreation activity, it will increase the risk; whereas a user who is highly experienced and competent in the same sport or recreation activity will have a lower the risk.

The user of this standard will need to make a choice between the quantitative analysis method, see 4.2, or the qualitative method, see 4.3.

4.2 Generic

4.2.1 General

- more product focused
- equipment
- more theoretical due to the probability/likelihood aspects
- "Equipment" includes elements that are intentionally brought into an environment for use in activities.
- include reference to intended use and foreseeable misuses

The risk assessment process described in this document is based on ISO Guide 51, and falls into the semi-quantitative approach to risk analysis. The basic process used remains the same regardless of the scoring methodology chosen. Fig. 2 illustrates the process flow.

4.2.2 Overview

Product risk assessment for sport and recreation can be expected, depending on circumstances, to follow more closely the industrial model of risk assessment in that risk minimization will be the norm, that is, products should not fail, e.g., climbing ropes, carabiners, play equipment structures etc..

On the other hand, the use of products such as playgrounds and climbing walls, etc., these will often require a degree of in-built risk in order to provide challenge and developmental opportunities through risk exposure. These risk assessments will be generic because they will likely be made far from the environment in which the products are used and without local knowledge.

4.2.3 Product or service life cycle

Benefit/risk assessment shall be undertaken at each stage in the lifecycle of the product, process, or service.

The benefit/risk assessment may include one or more of the stages of the lifecycle, as appropriate to the scope and purpose of the assessment.

The following shall be taken into consideration during benefit/risk analysis:

a) human interaction during the entire lifecycle of the product, process, or service with respect to the following:

   i) design;

   ii) construction or development of a facility or environment;

   iii) transport, assembly, and installation of structures and components and surfacing and other components in the environment;

b) commissioning or setting to use;

c) intended use of the structures and components and surfacing and other components in the environment; and

d) decommissioning, dismantling and, as far as safety is concerned, disposal;

4.2.4 Life cycle stages

Risk assessment shall be undertaken at each stage in the lifecycle of the product, process, or service. The risk assessment may include one or more of the stages of the lifecycle, as appropriate to the scope and purpose of the assessment.

The following shall be taken into consideration during risk analysis:

a) human interaction during the entire lifecycle of the product, process, or service with respect to the following:

   i) design;

   ii) construction or development of a facility or environment;

iii) transport, assembly, and installation of structures and components and surfacing and other components in the environment;

iv) commissioning or setting to use;

v) intended use of the structures and components and surfacing and other components in the environment; and

vi) decommissioning, dismantling and, as far as safety is concerned, disposal;

b) the possible states of the structures and components and surfacing and other components in the environment, as follows:

i) the structures and components and surfacing and other components in the facility or environment perform the intended function (i.e., it operates normally); and

ii) the structures and components and surfacing and other components in the facility or environment does not perform the intended function (i.e., it malfunctions or emergencies occur) for a variety of reasons; and

c) actions or reasonably foreseeable misuse of the structures, components and surfacing and other components in the facility or environment, e.g.,

i) loss of control of the structures and components o components in the facility of environment by personnel;

ii) reflex actions of a person in case of malfunction, incident, or failure during the use of the structures, components and surfacing and other components in the facility or environment;

iii) hazardous situations resulting from lack of concentration caused by the challenges of the activity or interaction with other users;

iv) hazardous situations resulting from taking the path of least resistance in achieving success with a challenge, resulting from pressures to keep the structures, components and surfacing and other components in the facility or environment operational in all circumstances; and

v) hazardous situations arising from actions of persons in and around the facility or environment.

Note: *The intent of item 4.1.2 (c)(v) is not to assign blame, but rather to ensure that the hierarchy of controls is applied.*

[Source CSA Z1002-12]

4.2.5 Intended Use

When preparing a benefit/risk assessment for a sport and recreation for all ages and abilities, developing an understanding of the intended use of the product, process or service is fundamental. The intended use shall take into account at least:

a) The intended use of the sport or recreation product, process or service, i.e., following rules of the game;

b) The reasonably foreseeable misuses of the sport or recreation product, process or service;

c) The ergonomics aspects, including the body sizes likely to be found in the intended user population, strengths and postures, movement amplitudes, frequency of cyclic actions (see ISO 10075 and ISO

10075-2);

d) The expected cognitive and intellectual level of development in the intended user population, including any limitations this might place on the user's ability to use the sport or recreation product, process or service safely;

e) The use of the sport or recreation product, process or service by persons identified by sex, age, dominant hand usage, or limiting physical abilities (visual or hearing impairment, size, strength, etc.);

f) Any training or experience that could be required to allow for the safe use of the sport or recreation product, process or service;

g) exposure of persons to the hazards associated with the sport or recreation product, process or service where it can be reasonably foreseen:

   i) persons likely to have a good awareness of the specific hazards;

   ii) persons with little awareness of the specific hazards but likely to have a good awareness of site;

   iii) persons likely to have very little awareness of the specific hazards.

If specific information is not available in relation to c), above, the responsible person(s) should take into account general information on the intended user population (for example, appropriate anthropometric data).

Intended use information should be assembled into an intended use statement that encompasses all of the information related the intended use(s) and reasonably foreseeable misuse(s) of the sport or recreation product, process or service. See X.X.X on Documentation for more information.

[SOURCE: ISO 12100:2010 with modifications and additions]

4.2.6 Reasonably Foreseeable Misuse

Reasonably foreseeable misuse can be when a service is used by an unintended user, i.e., a mismatch exists in physical size, age, skill, or physical ability, or when an intended user does something unintended with the service.

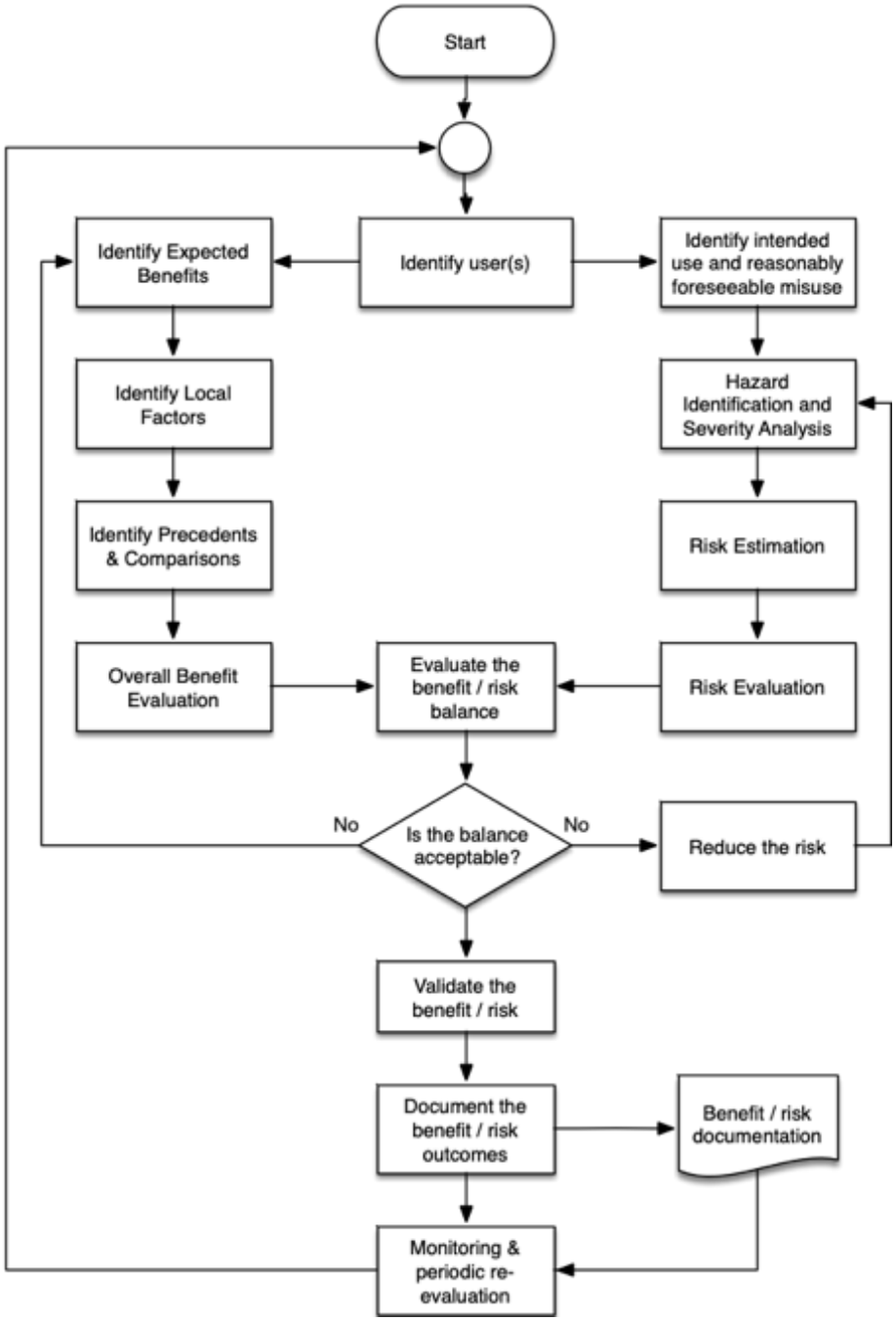
Local play culture can result in reasonably foreseeable misuse when a mismatch exists between the design of the service and the way the service is used.

There is a point where reasonably foreseeable misuse converts to abuse when:

— the behaviour becomes culturally unacceptable or

— when behaviour is impaired by substances or

— when the user ignores posted hazard warning signs and labels.



620

621 **Figure 2 - Benefit/Risk Assessment Process**

4.3 Site Specific

4.3.1 General

Site specific risk assessment includes the policy of the organization that is providing the facility or activity, e.g., physical fitness programs for senior citizens. Also included is consideration of the environmental factors, and the users that may be accessing the facility or the activity. Both physical site and the service(s) provided on the site by the owner/operator should be assessed.

All of the analytical steps included in the equipment risk assessment, see 4.3, apply to the site specific assessment, with the addition of the following considerations.

Site specific risk assessment can be used for permanent or temporary installations, e.g. a swimming pool or a temporary sporting event.

NOTE 1 A site specific risk assessment for a swimming pool might include identifying a damaged diving board, identifying a need to repair or replace the board.

NOTE 2 A baby pool might be located close to the deep end of a swimming pool. The owner/operator might decide to install a barrier and signage to help keep separation between small children and deep water.

NOTE 3 A playground is located in close proximity to a major roadway. The owner/operator might consider installing fencing or other appropriate barriers to maintain separation between the children and the traffic.

NOTE 4 The selection and layout of play equipment on a site would be part of a site-specific risk assessment.

The site-specific risk assessment shall address the risks associated with the intended use(s), the foreseeable misuse(s), and between individual pieces of equipment, the site where the equipment is to be installed, and the intended users. The site designer shall review the compliance with established equipment standards. In the absence of evidence of compliance, the residual risks determined by the supplier(s), and subsequently shall evaluate the risk associated with the installation of the equipment on the site.

4.3.2 Overview

This situation arises for managers of recreational facilities including national parks, off-road cycling trails, ski resorts etc., where there is a trade-off to be made between the benefits of exposure to these environments and the associated risk of harm. Note that in some cases exposure to harm, and hence challenge, is part of the benefit. The preferred risk assessment tool here is likely to be some form of benefit-risk assessment.

Site-specific risk assessment includes the whole facility taking into consideration the users of the site, the environment, and the products and services that may be present on the site. In site-specific risk assessment also considers the surroundings and the environmental conditions present on the site.

The risk assessment process may follow the same flow as that used for the generic risk assessment method.

Used by facility operators to optimize benefits and risks of activities taking account of interactions between users and hazards and making use of local knowledge.

4.3.3 Benefit/risk matrix

(Suggestions for proposed text welcomed.)

4.3.3.1 Low Benefit / Low Risk

— Watching TV

4.3.3.2 Low Benefit / High Risk

— Watching TV while consuming large quantities of high fat foods.

4.3.3.3 High Benefit / Low Risk

— Reading a book
— Walking in the park
— Watching TV while running on a treadmill or riding a stationary bicycle

4.3.3.4 High Benefit / High Risk

— Parkour
— Mountain biking

4.3.4 Facility or Activity

4.3.4.1 General

— Accessibility

4.3.4.2 Facility policy

(Suggestions for proposed text welcomed.)

4.3.4.3 Activity Leader

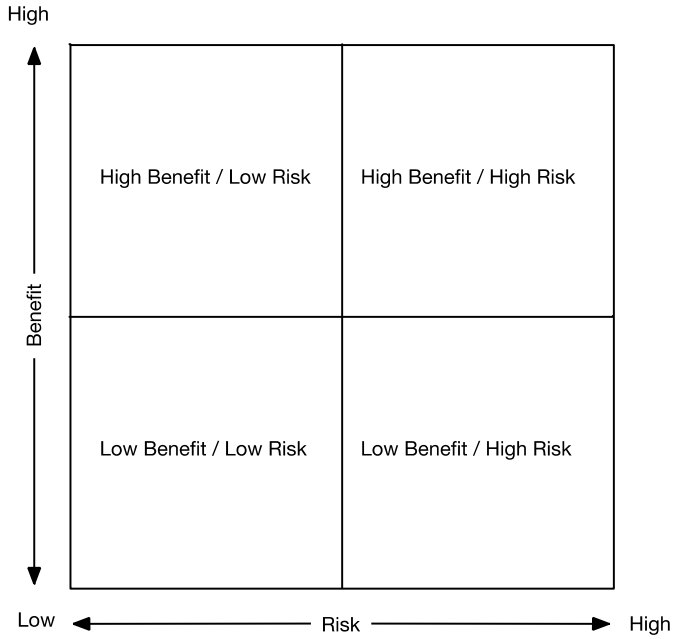
(Suggestions for proposed text welcomed.)

4.3.5 Environmental factors

— How the environment can affect the activity or equipment.
— How the environment can affect the life time of the product.

4.3.6 User or participant factors

— Number of users
— type of user (competence, age, ability...)
— size
— weight
— skill
— user traffic flow patterns
— UV/IR protection



694

695 **Figure 3 - Benefit/Risk Matrix**

696 ## 4.4 Dynamic

697 ### 4.4.1 General

698 The dynamic risk assessment method applies to active situations in which participants and activity
699 leaders are involved in some challenging activity. Risk assessment or benefit-risk assessment is here an
700 on-going mental process, referred to as dynamic risk assessment (or dynamic BRA), predicated upon
701 the prior experience and abilities of participants.

702 Figure 1 shows three general forms of risk assessment which could be expected to be utilized in the
703 sport and recreational sector. The third of these is that specifically conducted by activity leaders such as
704 park rangers, sports coaches and play workers and is referred to as dynamic risk assessment or
705 dynamic BRA.

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706 Dynamic risk assessment is a mental process, largely subconscious, which guides every action one
707 takes. The skill is acquired largely by trial and error as one grows and matures. Specialists in some sport
708 or recreational activity will acquire particular abilities through their immersion in the activity or
709 environment, and this is what provides them with the competence to act as guides or facilitators.

710 ### 4.4.2 Features of dynamic risk assessment

711 Dynamic risk assessment is an on-going process in which a leader will continuously update her risk
712 assessment through observing such things as the behaviour of participants, their capabilities, fitness
713 and endurance, the environment and the weather. Decision making is largely subconscious. Because of
714 this and its on-going nature it is not to be expected that it could be recorded, and it may even be that the
715 reasons for a particular choice at a specific moment are elusive (as with firefighter decision making).

The Activity Leader shall conduct a dynamic risk assessment in real time during the activity. Dynamic risk assessments may be documented. Dynamic risk assessments typically result in immediate changes to the site or activity.

NOTE 1 An example would be a lifeguard noting changes in water or weather conditions and adjusting the activity of the participants dynamically during the activity.

NOTE 2 The lifeguard notices that users are behaving in an unacceptable way, instituting a change in signage or behaviour.

4.4.2.1 Factors

- peer pressure – showing off
- concentration of people on the site
- boredom/thrill seeking
- impairment
- terrorism, bullying
- vandalism
- environment, weather conditions, lighting...

4.4.2.2 Elements of dynamic risk assessment

- Real time
- subconscious/implicit based on previous experiences
- not documented
- part of the feedback loop in thinking
- learned protective component
- biased based on experience
- instinctual protective component
- done by everyone
- Owner/Operator, Activity Leader, Country Rangers, User/Participant (sharp-end)
- Observational, immediate
- Environmental
- Variable based on experiential and cognitive ability
- maintenance

Examples of dynamic risk assessments

4.5 Benefits assessment

4.5.1 Benefits of sport and recreation

The public health benefits of sport and recreation are ~~now~~ widely recognized ~~but even so~~ are probably ~~still~~ under-valued. As research progresses new and surprising benefits are constantly identified for persons of all ages and circumstances. The main objective of providers of sport and recreational facilities is to maximize the public's gain, which includes physical, mental and social wellbeing and enjoyment.

An unusual feature of sport and recreation is that exposure to hazards and risk-taking is not always undesirable. For example, while a structurally unsound viewing platform would be unacceptable, the risky experience of a wobbly bridge in a children's playground, or of a precipitous mountain biking trail,

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might be acceptable because of developmental opportunities in the first example, and skill enhancement and enjoyment in the second examples. The former could be classified as a 'bad' risk and the latter two as 'good' risks.

In order to achieve this site operators need to have a clear policy setting out objectives. The approach to risk assessment will differ from that used by product developers. Here the role of the site manager is to consider both the benefits of the provision and the associated risks and strike a balance and the most appropriate tool is likely to be benefit-risk assessment.

Types of benefits:

— Physical,

— Social,

— Developmental,

— Health,

— Psychological/cognitive/emotional/spiritual,

— etc.

4.5.2 Quantitative benefit analysis

4.5.2.1 Quantifying benefits

Quantifying of benefits is challenging due to human's tendency to accept the benefit as "normal" situation. Injuries in contrast are easily exaggerated both in own thoughts and in public discussions.

Experts who created this ISO standard have consensus for the hypothesis that benefits from ~~play~~ are greater than most of the common risks. ~~Only question is how much and how to quantify the both for compar~~. This chapter creates the ~~first~~ theory to estimate the ~~ration~~ between benefits and the risk from ~~play~~ a[illegible]es.

4.5.2.2 Starting points

This chapter uses RAPEX directive (EU 2019/417) as a risk assessment method because it provides a tool to calculate likelihood for accident and provides acceptable risk level. In principle however, any risk assessment method should give similar results.

The RAPEX risk assessment method uses four level injury scale and gives acceptable likelihood for each. A simplified presentation of the injury levels and acceptable likelihoods for a specific accident during equipment's remaining lifetime is in Table 1.

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Table 1 - RAPEX risk assessment's levels of injuries

	Level 1	Level 2	Level 3	Level 4
Description	"Bruise"	"Bone fracture"	"Permanent loss of function"	"Death"
Acceptable likelihood during equipment's remaining lifetime	< 1/10	< 1/1000	< 1/10 000	< 1/100 000
Acceptable likelihood during single use	< 1/1 000 000	< 1/100 000 000	< 1/1 000 000 000	< 1/100 000 000 000

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Note. The acceptable likelihood given in RAPEX directive is for equipment's remaining lifecycle and for all users together. Considering that approximate lifecycle is 20 years and the daily number of users is 15, the likelihood for acceptable accident during a single use is 1/100 000 times smaller than the likelihood given in the table.

4.5.2.3 Comparison between risk and benefit

It is necessary to recognize the benefit side's counter-terms to those which are used to quantify injuries.

Hazard is a thing that exposes a user to thing bad. A thing that exposes user to something good is the **activity** itself.

Risk is normally unintended whereas its positive counterpart is **voluntarily engaged opportunity**.

Injury is the result of negative incident. Positive incident is **benefit.**

Figure 4 - Benefit/Risk parameter mapping

The next step is to understand what the counter-benefits to levels of injuries are.

Injury level 1 ≈ "Bruise" <=> Momentary benefit such as joy.

Likelihood for this benefit when using an equipment could be > 1/20 (engaging to 10 activities for example within the duration of 15 mins brings the benefit with 50% certainty)

Injury level 2 ≈ "Bone fracture" <=> Short term benefit such as learning a skill faster than without the activity or getting acquainted with new people.

Likelihood for this benefit when using an equipment could be > 1/1000 (engaging to 10 activities 2-3 times a week for a month brings the benefit with 10 % certainty)

Injury level 3 ≈ "Permanent loss of function" <=> Permanent improvement in lifestyle such as finding a friend or adopting an active lifestyle.

Likelihood for this benefit when using an equipment could be > 1/50 000 (engaging to 10 activities 2-3 times a week for 4 years brings the benefit with 10 % certainty)

Injury level 4 ≈ "Death" <=> Protection from causes of premature death such as depression (suicides) and obesity (diabetes and heart decease).

Likelihood for this benefit in equipment could be > 1/1 000 000 (engaging to 10 activities 2-3 times a week for 20 years brings the benefit with 5 % certainty)

Note. The level 4 estimate is derived from statistics in the following way: Under 19 years olds committed annually 40 suicides in Finland during past 20 years, this is 1/30 000 from the 1,2 million population of this age. At year 2017 total of 857 persons who were under 59 years old died to diabetes and heart ~~decease~~ in Finland. This is 1/4 700 from the 4,0 million population of this age. Likelihood for dying only for these two reasons is 1/4100. Playing protects from these two premature deaths with likelihood of 1/100 000 if it is considered plausible that increased physical activity decreases depression and obesity by less than 5 %.

4.5.2.4 Benefit evaluation

When comparing likelihoods for benefits to the likelihood for injuries as written before, it seems that the benefits are 20 000 to 100 000 times greater than risks as listed in Table 2.

Table 2 - Calculating benefit / risk ratios

	Acceptable risk	Estimated benefit	Ratio (benefit / risk)
Level 1	< 1/1 000 000	1/20	50 000
Level 2	< 1/100 000 000	1/1000	100 000
Level 3	< 1/1 000 000 000	1/50 000	20 000
Level 4	< 1/100 000 000 000	1/1 000 000	100 000

These numbers however reflect "common sense" and assumption that current equipment in the market reflect the benefit / risk ratio which the society seems to accept.

As a rough estimate, it could be concluded that when benefit / risk ratio is

- less than 10 000, the benefit necessarily doesn't justify the risk.
- 10 000 to 100 000, the benefit justifies the risk.
- greater than 100 000, the benefit highly outweighs the risk.

4.5.3 Benefit enhancement

Benefits that can be enhanced:

- Physical,
- Social,
- Developmental,
- Health,
- Psychological/cognitive/emotional/spiritual,
- etc.

(additional proposals for text welcomed)

4.6 Qualitative Benefit-Risk assessment

4.6.1 Conduct of the Benefit-Risk assessment

Unlike conventional risk assessment, benefit-risk assessment explicitly brings together consideration of risks and benefits when deciding on appropriate responses in what is known as a compensatory decision process. Responses could be in the form of, for example, engineering controls, behavioural measures, advice and warnings.

Judgments about the balance between risks and benefits can be seen as complicated because they involve many factors and are often partly subjective. For example, the age, ability, fitness and expectations of users will be influential as well as the presence of physical hazards and other local environmental and cultural considerations. So, whether designing a hiking trail or a waterslide, multiple factors will need to be considered. However, the reality is that all such decisions are of this nature unless heavily circumscribed, but heavily circumscribed decisions are unlikely to yield the optimum results through neglect of relevant factors.

Some recreational environments may also involve complex structures which go beyond everyday experience and judgments. For example, such things as structural stability, water hygiene, head traps or structures built into trees, for instance, may require technical knowledge and specialist expertise. However, other cases will not involve such expertise and decisions can be based on everyday experience, skills, knowledge and local awareness. Different situations will require different types and levels of personal or technical expertise and what is needed should be decided on a case-by-case basis.

4.6.2 The process stages

4.6.2.1 General

The first stage is to identify the intended benefits of the activity which can be wide-ranging. At Appendix 1 can be found a worked example which has been provided by the UK Play Safety Forum. The example deals with children's play situations but can be adapted for other sports and recreational facilities and activities.

Secondly, the risks of harm are recorded. At this point the site-specific nature of the assessment is enjoined. Local factors such as organizational policies, environmental factors, anticipated user groups, user interests and motivations are considered.

These two inputs are then brought together in a decision process. This can be aided by recourse to published research, historical evidence, and precedents from other agencies with similar situations and objectives.

In some jurisdictions it would be expected that a record would be kept of the decision process.

4.6.2.2 Features of the benefit-risk assessment process

Benefit-risk assessment as currently practiced differs significantly from sport and recreational product risk assessment. Historically the latter tends to follow a quasi-scientific approach to hazard identification and risk assessment which is reductionist in nature. In contrast, benefit-risk assessment as it has evolved is much closer to an holistic process. It does not attempt to break the process down into stages as is done in product risk assessment and, for example, give numerical ratings to risks and benefits and compare the two. It relies instead on the decision-making ability of those with extensive experience of the locality and / or activity, and it uses a narrative style to record the findings and decision process.

This is not to say that users of the benefit-risk paradigm must not use numerical rating schemes. That is a choice and it is recognized that such devices are widely used in industry and beyond. However, current opinion is that numeric rating schemes are in reality not more objective than holistic decision processes, nor more reliable, and users should be aware of this (see ISO 31010).

4.7 Risk Assessment

4.7.1 General

Risk is a combination of primary elements: a loss or harm, and the probability or likelihood of that harm. When considering risk to people, particularly children, the elderly or those with disabilities, who are a known vulnerable part of the population, risk is broken down into a combination of the severity of injury and the likelihood of that injury occurring.

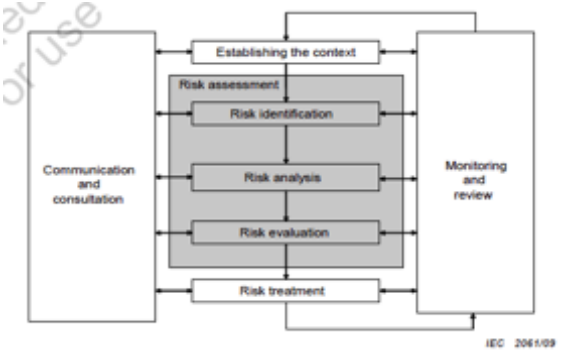

Figure 5 - Contribution of risk assessment to the risk management process [ISO 31010:2009, Fig. 1]

When considering the Severity of Harm, two aspects need to be determined:

— The range of harm that could result, and

— The most probable degree of harm likely in the circumstances

When considering the Likelihood of Harm, this parameter is broken down into at least three related parameters:

— Exposure to the hazard in terms of frequency and duration

— Likelihood of the exposure resulting in harm, the Likelihood of the Hazardous Event, and

— The Possibility to Avoid or Limit Harm.

The relationship between these parameters is shown in **Error! Reference source not found.**

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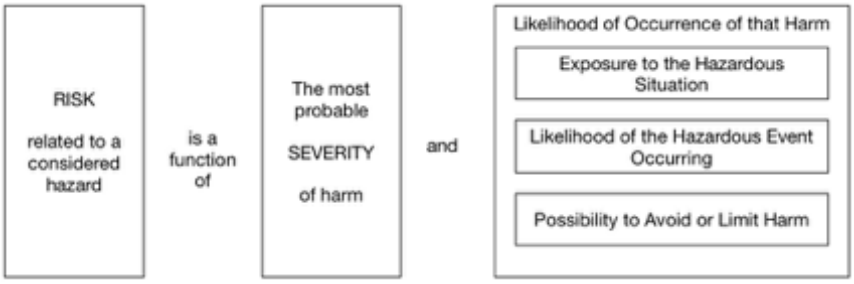

Figure 6 - Elements of risk [SOURCE ISO Guide 51:2014, Fig. 7]

Risk assessment can be under taken in varying degrees of depth and detail and using one or many methods ranging from simple to complex. These techniques fall generally into the following hierarchy:

a) qualitative;

b) semi-quantitative; and

c) quantitative.

The primary difference between the three classifications is the use of numeric data and mathematical analysis techniques to combine parameters affecting risk as opposed to using judgment based on experience. The fundamentals of the techniques remain the same regardless of which type of analysis is chosen.

The above list hierarchy starts with the methods that anyone can use and moves to the highest level of techniques that can require special technical skills to apply correctly.

Where a decision can be made regarding risk control based on a simple assessment method, this decision should be taken without further analysis; otherwise, more-complex assessment methods might be required to effectively assess the risk.

[SOURCE: CSA Z1002-12 A.2]

939 **4.7.2 Intended use(s) and foreseeable misuse(s)**

940

941 **4.7.3 Hazard identification and analysis**

942 [SOURCE: CSA Z1002-12, with modifications]

943 **4.7.3.1 General**

944 The responsible party should identify and analyze hazards and hazardous situations.

945 **4.7.3.2 Hazard identification**

946 Harm to persons is created by exposure to hazards. Hazards may include the conventional concepts,
947 and may also include prevention of participation in activities that bring benefit to the user.

948 Hazard identification shall take into account:

949 a) reasonably foreseeable hazards, hazardous situations, and hazardous events, and the potential
950 harm to users of the facility, or environment;

951 b) the different materials, parts, mechanisms, and activities provided by the structures, components or
952 apparatus;

953 c) the environment in which the activities are intended to be used;

954 d) foreseeable misuse of the structures, components or apparatus;

955 e) cognitive demands and psychosocial aspects that could contribute to the presence of hazards or
956 hazardous situations (see CSA Z1002-12 Annex B); and

957 f) all relevant phases of the lifecycle of the product, environment or space (see box).

958 Note: Monitoring of facility and space and over time can contribute to hazard identification.

959 **4.7.3.2.1 Identification of hazard sources**

960 Sources of hazards and hazardous situations shall be identified. Sources can include, but are not limited
961 to, the following:

962 a) objects (e.g., equipment, materials, etc.);

963 b) chemicals;

964 c) biological agents;

965 d) physical agents (e.g., sources of energy, high or low temperatures, etc.);

966 e) animals;

967 f) people and play, recreation or sport environment users; and

968 g) physical or cognitive interaction of the user with the product or space.

969 Note: See CSA Z1002-12 Annex B for more information on hazard sources.

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4.7.3.2.1.1 Analysis of hazard sources

Each source should be analyzed, based on available data, to determine how it can potentially harm a user of or bystander in the environment.

The analysis should include the:

a) characteristics of the source;

b) conditions under which the source can cause harm, including the

i) amount (i.e., concentration, intensity, or force) of the source that can cause harm through a particular means;

ii) means by which the source can cause harm (e.g., inhalation, ingestion, absorption, injection, or transference of energy); and

iii) frequency and/or duration of exposure of a user to the source at the amount and through a particular means at which the source can cause harm;

c) interaction of the user with the source; and

d) the potential severity of harm presented by the hazard.

NOTE Frequency and severity are used as inputs to the analysis of hazard sources to help determine whether and how the source has the potential to cause harm.

4.7.3.2.1.2 Analysis of multiple sources

When multiple sources have been identified, the analysis shall include the effect of any overlap, interaction, or accumulation of the sources. When two or more risks in a single scenario are not connected to a single user scenario, they are assessed as separate risks.

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Analysis of hazard sources should be based on

a) scientific data (e.g., material safety data sheets, engineering data sheets, and physical demands tables);

b) systematic team approaches;

c) inductive reasoning techniques;

d) incident histories;

e) taking of measurements (e.g., air samples and noise, force, and distance measurements);

f) reviewing playing space organization;

g) observation of users in similar circumstances; and

h) consultation with users, caregivers, and other stakeholders.

4.7.3.2.2 Activity identification

User activities associated with sources of hazards should be identified. The identification of activities should include:

a) user interaction with structures, components and surfacing and other components in the facility. environment and space;

b) the environment; and

c) cognitive demands.

4.7.3.2.3 Hazard eliminatio

Only after hazards have been identified can steps be taken to eliminate them or reduce risks. For the purpose of risk assessment, it is assumed that, when present, a hazard, or a combination of hazards, will lead to harm if measures are not taken to eliminate hazards or implement protective measures.

When a hazard cannot be immediately eliminated, interim controls shall be implemented until the risk assessment is complete and permanent controls can be implemented. This would apply to existing facilities or environments installed prior to the publishing of this Standard.

4.7.4 Risk analysis

4.7.4.1 General

Risk analysis includes the estimation of the severity of harm and the likelihood of occurrence of harm in accordance with 4.7.4.2 and 4.7.4.3.

4.7.4.2 Severity of harm

The risk analysis process shall include a scale to determine the severity of harm. The scale chosen should produce results that will best serve the risk reduction process.

The severity of harm resulting from a hazardous event or combination of hazardous events can be determined by estimating the potential degree of injuries, illness, or damage to the physical or mental health of the users.

4.7.4.3 Likelihood of occurrence of potential severity of harm

4.7.4.3.1 General

The likelihood of occurrence of potential severity of harm is a function of

a) exposure of persons to the hazard(s) or hazardous situation(s), including any overlap, interaction, or accumulation from multiple sources (see 4.3.4.3.2);
b) the occurrence of the hazardous event (see 4.3.4.3.3); and
c) the possibility of avoiding or limiting the harm (see 4.3.4.3.4).

4.7.4.3.2 Exposure

When determining the overall exposure of users to a hazard or hazardous situation, the following shall be considered:

a) need for exposure;
b) nature of exposure
c) time spent exposed;
d) number of persons exposed; and
e) frequency of exposure.

4.7.4.3.3 Probability of occurrence of the hazardous event

When estimating the probability of the occurrence of a hazardous event, the following factors shall be considered:

a) reliability and other statistical data;
b) accident history;
c) history of damage to health; and
d) reasonably foreseeable use of the facility, environment, component or the space by the users.

4.7.4.3.4 Possibility of avoiding or limiting the harm

When estimating the possibility of avoiding or limiting harm, the following factors shall be considered:

a) how quickly the hazardous situation could lead to harm (e.g., suddenly, quickly, or slowly);

b) the physical ability of the user to avoid or limit harm (e.g., physical condition, physical attributes, reflexes, and agility); and

Note: The intent of this Item is to identify situations where the physical demands of the task might exceed the user's physical abilities, which could result in harm. This should be used to help identify effective controls to protect the user.

c) the cognitive ability of the user to detect and understand the sequence of events that could lead to a hazardous situation or harm.

Note: See Annex A of CSA Z1002-12 for additional guidance on risk analysis.

4.8 Risk Evaluation

4.8.1 General

The purpose of risk evaluation is to make decisions about

a) whether an activity should be provided in a public, unsupervised setting, taking into consideration the type of facility and the presence of supervision;
b) which risks need to be controlled;
c) the priority with which the risks will be addressed; and
d) future actions.

4.8.2 Comparison to risk criteria

The risk criteria shall follow local legislation and regulations. Where no risk criteria is set by legislation or regulation, the risk criteria may be set by the responsible person, sports federation or by national or regional bodies based on risk appetite.

The level of risk shall be compared to the risk criteria to make risk control decisions.

If the result of the risk evaluation shows that the risk level complies with the existing risk criteria, then no justification based on the benefits of the activity is required. However, where the risk criteria are exceeded, comparison of the risk with the benefits can be used to justify the activity.

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Comment [3]: Unresolved in the Tokyo meeting.

4.9 Likelihood analysis

4.9.1 Likelihood of occurrence of potential severity of harm

4.9.1.1 General

The likelihood of occurrence of potential severity of harm is a function of

a) exposure of users and bystanders to the hazard(s) or hazardous situation(s), including any overlap, interaction, or accumulation from multiple sources (see Clause 6.1.2);
b) the occurrence of the hazardous event (see Clause 6.1.3); and
c) the possibility of avoiding or limiting the harm (see Clause 6.1.4).

4.9.1.2 Determining exposure

When determining the overall exposure of users to a hazard or hazardous situation, the following should be considered:

a) need for exposure;
b) nature of exposure;
c) time spent exposed;
d) number of persons exposed; and
e) frequency of exposure.

4.9.1.3 Estimating the likelihood of occurrence of the hazardous event

When estimating the likelihood of the occurrence of a hazardous event, the following factors should be considered:

a) reliability and other statistical data;
b) accident history; and
c) history of damage to health.

4.9.1.4 Estimating the possibility of avoiding or limiting harm

When estimating the possibility of avoiding or limiting harm, the following factors should be considered:

a) how quickly the hazardous situation could lead to harm (e.g., suddenly, quickly, or slowly);
b) the physical ability of the user to avoid or limit harm (e.g., physical condition, physical attributes, reflexes, and agility); and

Note: The intent of this item is to identify situations where the physical demands of the activity might exceed the user's physical, or cognitive abilities, which could result in harm. This should be used to help identify effective controls to protect the user.

c) cognitive ability of the user to detect and understand the sequence of events that could lead to a hazardous situation or harm and the consequences that could result from the action. This will include an assessment of the user to judge the level of challenge being presented and applying their ability to avoid the hazard.

4.9.1.5 Level of risk

The estimation of likelihood and severity of harm shall be combined to determine the level of risk of a hazard or hazardous situation. The level of risk shall be expressed in suitable terms for the type of risk and in a form that aids risk evaluation.

5 Determining the benefit/risk balance

After the assessment of benefits and risks, a comparison shall be made.

Where the risk meets the risk criteria, then the benefits need not justify the risks.

Where the risk is greater than the risk criteria would normally allow, then the benefits shall outweigh the added risk

If the balance is found to exist, this can be reported in a narrative fashion.

6 Benefit enchancement and risk control

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6.1 General

Following the evaluation of the benefits and the analysis of the risks, the balance between the benefits and the risks should be considered, see Figure X (flowchart). If the balance is unsuitable, the risks may be controlled or the benefits may be enhanced to achieve a suitable balance.

Note: For example, if an activity has graduated levels of risk based in part on some aspect of activity, then the user can pick a level of risk that is appropriate for their particular skill level. If the risk is not increased, users might eventually lose interest in the activity.

6.2 Benefit enhancement

Benefit enhancement is the process of improving the health and welfare of the group served by the service. The benefits can be enhanced in many ways, for example:

— increase the challenge in the activity

— increase the skill level required of the activity

— increase the social benefits of the activity

— increase the exposure to nature and the elements

6.3 Risk control

Risk control is the process of increasing or decreasing the level of risk to achieve a suitable balance. Decreasing the risk may be the easiest approach to correcting the balance, however, in some circumstances, increasing the risk may also increase the benefits of the activity, thereby achieving a suitable balance.

Risk control measures can include:

— Increasing the surveillance of the activity

— Adding engineering controls

7 Documentation

7.1 General

All of the analytical processes shall be documented at a general level.

The particulars and the qualifications of the assessor(s) shall be recorded in the documentation.

7.2 Benefit assessments

The benefit assessment shall be documented. If an established method is used, the provenance of the method shall be documented. If no established method is used, then the approach and rationale used in the analysis shall be documented.

7.3 Risk assessments

The risk assessment shall be documented. Scoring methods used in the risk assessment shall have the provenance of the scales documented.

7.4 Benefit/Risk Balance

The method used to determine the benefit/risk balance shall be documented including the approach and rationale used in the analysis.

8 Training and competency

8.1 General

A competent person or a competent body shall provide evidence of the claimed competency.

Competent organizations shall provide training based on recognized methods. Trainers shall have documented expertise in benefit/risk assessment and in training methods and techniques.

8.2 Content

The training program shall be comprehensive, covering all aspects of this standard.

The training program shall provide documentation of the learning objectives and the limits of the training program.

Continuing education is expected for competent persons.

8.3 Required competency

Dunning-Krueger - “You don’t know what you don’t know!”

Competency is defined as a combination of knowledge and experience. Competent persons shall have a minimum level of experience following the initial training before they begin to practice unsupervised.

9 Performance evaluation

9.1 General

The effectiveness of the benefit/risk assessment shall be evaluated. The evaluation of the benefits, risks, enhancements and controls shall include:

a) the verification, e.g., does the assessment cover the correct service,

b) validation, e.g., have all aspects of the service been included in the assessment, and

c) acknowledgement of the results of the assessment, e.g., the assessors should affirm the results for the assessment.

The verification shall ensure that the benefit/risk assessment reflects the actual configuration of the service, including the equipment, and site specific aspects.

9.2 Periodic Evaluation

9.2.1 General

The accuracy and comprehensiveness of the benefit/risk assessment for the service shall be reviewed and evaluated periodically. The frequency of the evaluation shall be determined by the responsible person(s).

Annex A
(informative)

Play Safety Forum Risk-Benefit Assessment

(Text to be taken from the RBA needs to be discussed and agreed upon before insertion in this annex.)

Annex B
(informative)

Risk Scoring Tools

B.1 Risk Scoring Tools

[SOURCE: CSA Z1002-12, Annex A with modifications]

B.1.1 General

The primary objective of the users of a risk-scoring tool is to rank the different hazardous situations in accordance with the risk of injury to a user in order to assess risks, evaluate the results, and prioritize interventions. Risk assessment is a process that is most effective when undertaken by a multidisciplinary team but does not preclude an individual from completing an assessment. The ultimate purpose of the risk assessment is the selection and implementation of appropriate preventive and protective measures.

B.1.2 Key features

B.1.2.1 Forms

Risk scoring tools can have different forms, e.g.,

a) two-dimensional matrices;

b) matrices greater than two-dimensional;

c) risk graphs;

d) numerical operation methods;

e) graphical methods; and

f) hybrid methods using several approaches.

B.1.2.2 Risk Parameters

Some of the parameters used in risk scoring tools are

a) severity of harm;

b) likelihood of occurrence of harm;

c) frequency and/or duration of exposure;

d) probability of occurrence of a hazardous event; and

e) technical and human possibilities to avoid or limit the harm.

B.1.2.3 Risk assessment tools

Risk assessment tools vary based on

a) the descriptions and definitions of each parameter;

b) the number of parameters;

c) the granularity of the scales of the parameters;

d) the methods used to calculate and describe the risk; and

e) the methods used to classify or evaluate the final result.

This variation is a reflection of the different needs of users of these tools (i.e., tools can be modified and custom-made).

B.1.2.4 Selection or design of a risk assessment tool

Considerations when choosing or designing a risk assessment tool should include the following:

a) the number of parameters (two or four parameters depending on the amount of detail required);

b) the relative weight or contribution of each parameter should be carefully defined prior to the use of the tool in order to avoid a condition where one parameter overly influences the risk level;

c) the care that has been taken with regard to defining and documenting each parameter (e.g., differentiating between the likelihood of harm and the probability of the hazardous event)

d) the care that has been taken with regard to defining and documenting the scales for each parameter. If one word is used to define a level within a parameter scale, additional information should be provided to help users choose an appropriate threshold;

e) the use of at least three levels for the severity parameter. Tools with two levels for this parameter tend to make it more difficult to properly recognize some intermediate situations, producing odd risk estimation results in some circumstances (the majority of risk assessment tools use between three and five levels);

f) the use of at least three levels for the likelihood of harm parameter in or der to be consistent with the majority of risk assessment tools; Note: Chinniah, et al. [3] advises using between three and five levels to be consistent with the majority of risk assessment tools.

g) the use of at least four levels of risk. Tools with fewer risk levels over estimate risk in many circumstances. (These levels of risk are the output of risk analysis);

h) the avoidance of discontinuities or gaps in scales for parameters; Note: Discontinuities or gaps in the scale make it difficult to define exposure that does not fit the chosen parameters. For example, if parameters of once per contact with a specific element vs. once per trip to the sport or recreation facility or environment are chosen, a frequency of exposure of twice per day does not fit either parameter and can lead to errors. The frequency of exposure could be better defined with a reference such as X per contact with the component or activity

i) the avoidance of using the same word or phrase to describe two different parameters or thresholds within the same parameter scale;

j) the ability of the input parameters to provide an even distribution of output risk levels. This implies that each level of each parameter throughout the entire range of inputs should provide reasonable access to a good number of risk levels and that no output risk level predominates in the risk matrix;

k) the avoidance of tools whose outputs are overly sensitive to a single incremental change of an input. Such discontinuities affect the distribution of the results and also lead to a parameter that contributes unevenly in the determination of the risk; and

l) the importance of choosing or designing risk assessment tools appropriate to the scope of the risk assessment. The scope of the risk assessment can be used to determine the parameters that are required and the scale ranges that are needed within the parameters, e.g., a tool in which multiple deaths are required in order to reach maximum risk output is undesirable.

B.1.3 Severity parameter

B.1.3.1 General

A key element in the development of a risk characterization is the severity of harm, actual and potential, to the user of any aspect of the sport or recreation facility or environment. Injury severity is relatively easy to understand, as the assessor should have experience with injury descriptions and the associated severity. The assessor should select severity parameters that use at least three degrees and understand that utilizing more levels can add clarity to the results.

The assessor should select a severity parameter that is widely used to allow for transparency, consistency and flexibility to the risk assessment at any time within the life cycle of the structures, components and surfacing and other components in the environment, e.g., AIS Scale, Health Canada or RAPEX scales.

B.1.3.2 Abbreviated injury scale

The Abbreviated Injury Scale (AIS), developed and maintained by the Association for the Advancement of Automotive Medicine, is an anatomically based 6 level scale using medical terminology to describe injuries and their severity. The levels are (1) minor, (2) moderate, (3) serious, (4) severe, (5) critical, (6) maximum (untreatable). Many medical institutions assign an AIS code to the patient record at the time of intake, assessment or admission or following the review of the medical records. The AIS scale is referenced in the ISO/TR 20183.

B.1.3.3 Health Canada scale

Health Canada provides a “Consumer Product Safety Program Risk Characterization Methodology” under the Health Canada Consumer Products Safety Program. This document uses a scale of five severity levels: (1) Minor, (2) Moderate, (3) Severe, (4) Life-threatening or Disabling and (5) Fatal. Health Canada also provides the Health Canada Injury Coding Manual. This document places (3) Severe and (4) Life-Threatening or Debilitating under a single severity of “Significant”. The Coding Manual provides injury descriptions that should be of assistance to the assessor in categorizing injury and severity.

B.1.3.4 RAPEX Scale

The risk scoring tool described in the EU Commission Decision [5] includes a scenario based approach using a severity scale that includes four degrees of severity with variable meaning depending on the type of injury, e.g., bruise, laceration, concussion, entrapment, etc.

B.1.3.4.1 Likelihood parameter

B.1.3.4.1.1 General

Probability provides a numeric measurement of outcome and therefore becomes a part of the determination of risk. It is not always possible to provide a numeric value, but the outcome is expressed in words which can be assigned a numeric value.

B.1.3.4.1.2 Qualitative measures

Likelihood is the term we use when dealing with qualitative probability. This change in terminology is used to remind us that we do not have actual numeric data to work with. For example, likelihood might be described as "negligible", or "unlikely" or "certain". If these descriptions were used in a semiquantitative scale, then we might write "0 - Negligible" or "1 - Unlikely" or "5 - Certain."

When using likelihood to define potential outcome it is beneficial to use at least five degrees, e.g., negligible, unlikely, possible, probable, certain.

Once the likelihood or probability is converted to a number the formula R= S x P, where R is Risk, S is Severity, and P is Probability, can be applied and S and P are called risk parameters. For some applications this could be overly simplistic, therefore other methods of evaluating the risk may be used.

B.1.3.4.2 Frequency and duration of exposure parameter

B.1.3.4.2.1 General

The Frequency and Duration parameter deals with how often a person is exposed to the hazard or the duration they are exposed to the hazard or both. For the situations found in the sport and recreation, the frequency of exposure is often determined by the user and a matter of choice.

There will be circumstances where the user can be placed in a hazardous situation based poor choice or the consequence of a failure to achieve a challenge. The assessor should consider the duration of exposure in to all aspects or levels of exposure.

B.1.3.4.2.2 Duration

The duration is the length of time the user is exposed to the hazard.

B.1.3.4.2.3 Frequency

The frequency and duration are combined to consider the total exposure.

B.1.3.4.3 Probability of the hazardous event

The hazardous event is the instant in time when the harm is done to the exposed user. The first requirement is that a hazard must exist. This hazard may be static or continuously present and need an action on the part of a user or a person interacting with the user to create the hazardous event.

B.1.3.4.4 Possibility to avoid or limit harm

A significant aspect of harm prevention is the avoidance of harm. The Possibility to avoid or limit harm is not an engineering mechanism with the apparatus as avoidance is user related. The assessor must consider that based on knowledge, skill level, age or other factors, if the user is likely to make the decision to avoid the harm.

B.2 Example Risk Scoring Tool

B.2.1 General

The risk assessment will be further developed to be:

Risk = Severity x Frequency and Duration x Probability of the Hazardous Event x Possibility to Avoid harm

There are many risk scoring tools that can be used to measure the risk. A risk-scoring tool should incorporate at least 3 levels of severity and 5 would be ideal. A risk-scoring tool should incorporate at least 3 levels of probability of harm and more would be assistive in refining the assessment of risk.

Table 2 is a sample scoring tool, where Class = [Pr x (Fr + Av)] and Pr is the Probability of the Hazardous Event, Fr is the Frequency/Duration of the Exposure and Av is the Possibility to Avoid or Limit Harm.

Table B.3 - Risk Scoring Matrix

	Probability of Injury Class				
Severity	**3-10**	**11-20**	**21-30**	**31-40**	**41-50**
4	12-40	44-80	84-120	124-160	164-200
3	9-30	33-60	63-90	93-120	123-150
2	6-20	22-40	42-60	62-80	82-100
1	3-10	11-20	21-30	31-40	41-5-

The risk ranking can be established from the scoring tool as outlined in Table B.3.

Doug Nix 2019-12-27 16:13
Deleted: Table A.1

Table B.4 - Approximate Risk Ranges

Approximate Risk Ranges				
1-10	11-20	21-100	101-150	151-200
Very Low	Low	Moderate	High	Very High

B.3 Other methods

There are many methods of risk assessment and the assessor is encouraged to review the methods that are available. The tool being used to determine the risk of harm should be comprehensive and take on a system approach rather than a segmented approach as the sports and recreation includes the entire environment with structures, surfaces and most importantly the vulnerable users.

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