



DIRTT 2.0

REPORT ON SUSTAINABILITY AND INCLUSION

September 2025



ABSTRACT

This report explores the role of sustainability and inclusion in mountain bike trail building, with a focus on integrating these principles into the DIRT 2.0 Competence Framework.

Sustainability is examined through environmental, economic, social, and cultural dimensions, highlighting the need for a holistic approach to trail development.

Inclusion is addressed as a distinct yet interconnected concept, encompassing social, educational, and labour dimensions to ensure broader accessibility and equity in trail planning, construction, and maintenance.

A sector-wide survey conducted as part of the DIRT 2.0 project provides insights into current industry knowledge and practices related to sustainability and inclusion. The findings indicate strong support for embedding sustainability across all phases of trail development but reveal gaps in the routine application of inclusive principles.

The report also examines the relationship between shared-use and bike-only trails, assessing their impact on user experience, safety, and long-term trail sustainability.

In response to these findings, the report presents refined learning outcomes within the DIRT Competence Framework, ensuring that sustainability and inclusion are embedded in trail builder education and training.

The conclusions emphasise the need for a structured yet adaptable approach, balancing global sustainability goals with local trail-building realities. By integrating these principles, the mountain biking sector can foster responsible trail development that enhances environmental stewardship, economic viability, and inclusive outdoor recreation opportunities.

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LIST OF ABBREVIATIONS

aMTB	Adaptive mountain biking
DIRTT	Developing intereuropean resources for trail builder training
EQF	European qualifications framework
EU	European Union
IMBA	International mountain bicycling association
MTB	Mountain biking
SDGs	Sustainable development goals
UN	United Nations
TTF	Technical trail features



Photo: Magnus Grönberg

1. INTRODUCTION

1.1. ABOUT THE DIRT T PROJECT

The popularity of mountain biking is booming, amplifying the need for more trails and skilled trail builders to plan, design, construct and maintain sustainable trail infrastructure across Europe. This was the impetus for the DIRT T (Developing Intereuropean Resources for Trail builder Training) project in 2019, started by Viken Higher Vocational College in Norway and an international project group representing both volunteer and professional trail builders, education providers, municipalities, and tourist destinations. In the first project phase, DIRT T developed a mountain bike trail educational framework and study programme, leading to Europe's first formal education for Mountain Bike Trail Planning, Construction and Maintenance at Viken Higher Vocational College. The program was launched in September 2022 with a total of 25 students from 12 different countries. Thanks to renewed support from the European Commission, DIRT T is currently developing the existing framework into a European-wide trail builder certification program, planned for a 2026 launch.

1.2. SUSTAINABILITY

In 1983, the United Nations General Assembly established a special commission with the purpose of preparing a report on the environment, thus creating the World Commission on Environment with the aim of finding strategies that would lead to a new concept of "sustainable development". The Brundtland Report – Our Common Future, was presented in 1987 and aimed to reconcile countries' emerging concerns about the environment, defining perceptions and objectives that would lead to success in protecting and enhancing the environment – "A global agenda for change".

For the first time the term "sustainable development" was used, being defined as the development that "meets the needs of the present without compromising the ability of future generations to meet their own needs". The report helped bring sustainability into the mainstream of policy discussions (adapted from Our common future: Report of the World Commission on Environment and Development. Oxford University Press, 1987).

Nevertheless, it took years (or even decades) to popularise the concept of sustainable development and, more importantly, to implement it. Sustainable Development has become the centre of recent national policies, strategies and development plans of many countries, but it does imply limits – "not absolute limits but limitations imposed by the present state of technology and social organisation on environmental resources and by the ability of the biosphere to absorb the effects of human activities".

Yet, in the end, sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future, as well as present needs (adapted from Owusu, P. A., Asumadu-Sarkodie, S., & Dubey, S., 2016). A review of renewable energy sources, sustainability issues and climate change mitigation. *Cogent Engineering*, 3(1).

1.3. INCLUSION

Closely connected to sustainability is the concept of inclusion, which has gained growing recognition as a pillar of sustainable development. Inclusion refers to ensuring fair access to opportunities, services, and participation, regardless of background, ability, or circumstance. (UNESCO, 2023). In the context of trail building, inclusion refers to removing barriers—physical, social, and systemic—that limit participation in trail use, design, and construction (adapted from American Trails, 2025, *Why trails matter: Trails build community*). A truly inclusive approach to trail development considers the diverse needs of users, including individuals with disabilities, different skill levels, and varying socio-economic backgrounds.

Adaptive mountain biking (aMTB) is an emerging area that highlights the importance of inclusive trail design, ensuring that trails accommodate riders using specialised equipment. Factors such as trail width, slope gradients, and surface materials must be considered to create a safe and enjoyable experience (Kootenay Adaptive, 2021). Similarly, social and educational inclusion efforts aim to expand opportunities for underrepresented groups, such as youth from disadvantaged backgrounds or individuals seeking employment in the trail-building sector (We Bike Together – EU Project, 2022).

Inclusion in the trail-building workforce is also a key consideration, focusing on equitable access to training, employment, and career progression. Promoting inclusive labour practices fosters a diverse and skilled workforce while strengthening the long-term sustainability of the sector (Campbell, 2021). By embedding inclusion into all stages of trail development—from planning and design to construction and maintenance—the mountain bike industry can create environments that provide meaningful recreational opportunities for all, reinforcing the role of trails as shared community assets (IMBA, 2017).

2. CONTEXT

Following the detailed analysis of the DIRT 1.0 stakeholder and consumer survey report on the trails sector, the importance of deepening knowledge about the definitions and concepts of sustainability and inclusion was highlighted in order to address emerging concerns in the creation and maintenance of inclusive and sustainable recreational infrastructure. These insights then served as the basis for developing and refining the necessary learning outcomes for trail building curricula.

In the world of trail planning, construction, management and maintenance, knowledge about inclusion and sustainability plays an important role, given its definition and application in this area of mountain biking. While trail sustainability has often been narrowly defined as minimising environmental impact and degradation while accommodating visitors, with a broader definition, we can approach sustainability in trails and trail building using the three dimensions of sustainability (environmental, economic and social). Inclusion in trail development is often associated with ensuring physical accessibility for users with disabilities, such as adaptive mountain biking (aMTB) (Kootenay Adaptive, 2021). While this is an important aspect, inclusion extends beyond physical access to encompass broader social, educational, and labour dimensions.

In the latest research, a cultural sustainability element is suggested to expand the former three dimensions of sustainability and introduce a more holistic approach for sustainable trails and trail building (Campbell et al., 2021). As with sustainability, an inclusive approach requires recognising the cultural and contextual factors that shape trail development reflecting the values of societies and, therefore, playing a fundamental role in building a more inclusive and sustainable future. The specificity and cultural diversity of each place, region or country reflects the need to integrate different concepts of sustainable development, respecting the inherent norms, beliefs and customs, traditions, and ways of expression; in sum, the values of a particular community, adapted to the environment in which they live. An integral and integrated approach to “sustainability in the construction of mountain bike trails, which takes into account the local context rather than adopting a one-size-fits-all approach” is therefore essential (Campbell et al., 2021).

2.1. SUSTAINABILITY CONCEPT AND ITS DIMENSIONS

A sustainable approach in trail building rests on the three dimensions of sustainability: social, environmental, and economical, plus the cultural aspects mentioned above for a more holistic approach. As such, we could try to define a sustainable trail as one that provides a safe and fun experience for trail users (Saeger, E. 2023), while minimising impacts on the natural environment (soil, wildlife, plants), promoting nature awareness and landscape, involving local community (has its respects and values local heritage and legacy), while producing economic value for the region, allowing for ongoing maintenance which upholds the quality of the trail. The following section will refer to each dimension independently.

2.1.1. ENVIRONMENTAL SUSTAINABILITY

Will the trail provide for natural resource protection? This is the definition that is commonly used when referring to what does or does not provide for a sustainable trail. There are more detailed dimensions within environmental sustainability, such as physical sustainability of the trail tread vs layout and alignment, so the trail is planned and constructed in the right place where limited impact on landscape, fauna, and flora needs to be minimal. However, the trail also plays a role in enhancing the appreciation and understanding of nature by fostering direct interaction with natural areas, encouraging environmental awareness, and promoting respect for local values. For instance, the materials used should prioritize natural solutions, recycled materials, or other options with little to no impact on nature.

Environmental sustainability in trail building aims for a trail system that minimises ecological impact on the land, fauna and flora as much as possible. To achieve limited impact the trail builder must understand and mitigate the environmental impact of the trail or trail system during the planning, design, building and maintenance phases. Based on this, there are several aspects to take into account that allow trail infrastructures to be “environmentally sustainable”, such as the use of renewable energy sources, recycling and reuse of materials, replanting of native flora (such as conservation of species, water, soil and biodiversity), and efficient use of water resources.

In Guidelines for a Quality Trail Experience (2017), the International Mountain Bicycling Association (IMBA) refers to environmental sustainability “in the context of trail development includes an environmental review process used to make informed decisions that protect, restore, and enhance the environment by understanding potential environmental consequences from the proposed project. It is necessary to work through the environmental review process to ensure compliance with environmental laws and regulations. In this context, “the environment” includes both natural and cultural resources.”(IMBA, 2023).

In this guide book, IMBA proposes a set of measures in the design, construction and maintenance of mountain bike trails in order to implement bike-optimized mountain bike trails in the communities, highlighting all aspects related to its sustainability, which reflects a paradigm analysed in Sustainable mountain bike trails (Campbell, 2023), since “while purpose-built trail centres and bike parks can divert mountain bikers away from more sensitive areas, thereby protecting ecosystems and reducing conflict (Taylor & Sand, 2021), they may not satisfy all riders’ appetites for natural technical trails (Gibbs & Holloway, 2018), previous research has shown that most European riders admit to using illegal or unauthorised trails”. “It is therefore important not to assume that unauthorised trails are inherently less sustainable than authorised trails, as they can contribute to broader sustainability, namely from a cultural point of view, by promoting experiences that reflect the needs of mountain bikers in that specific area, maintaining their connection to nature and creating motivations that lead them to participate in the maintenance of the trails themselves and the surrounding natural space, since “despite the persisting belief that mountain bikers are motivated by a sense of risk and danger, there is a growing body of evidence to demonstrate that enjoyment of nature is a much more powerful source of motivation” (Roberts, 2018; Campbell et al., 2021).

In the book *Mountain Biking Culture and Society*, collated by Jim Cherrington, Assoc. Prof. Tom Campbell addresses the importance of considering different riders to ensure that the experiences sought by mountain bikers are considered when developing trail plans, stating: “In mountain biking, for instance, rider behaviors are arguably the most important determinant of the ecological impact of trail use and therefore need to be fully understood in order to progress the discourse of sustainable trails. In terms of trail use, current trends suggest that trail and enduro riding are becoming the most prevalent (Vital, 2020; Campbell et al., 2021; IMBA, 2021) and these riding styles encompass the use of a wide range of trails, including machine built, hand-dug and wild, or natural, with enduro tending towards more natural, downhill-orientated tracks”.

2.1.2 ECONOMIC SUSTAINABILITY

“Economic sustainability” in trail development refers to ensuring long-term financial viability while balancing environmental responsibility. It involves applying financial, administrative, and policy strategies that support economic development without compromising natural resources. Sustainable economic policies can encourage investment in trails through mechanisms such as tax incentives, funding programs, and public-private partnerships. These investments can create jobs, generate local revenue, and reduce long-term maintenance costs by ensuring high-quality construction from the outset. A well-planned trail system can contribute to the local economy by attracting tourism, supporting businesses, and fostering community engagement—all while maintaining a balance between economic benefits and environmental protection.

Economic sustainability in trail building must meet different economic considerations. Will the trail or trail system grow the local and regional economy? Will the trail or trail system ensure that the trails are built to a standard that meets the requirements of the anticipated trail user preferences and pressure? Will the trail or trail system be built to a standard that minimises maintenance costs in the maintenance phase of the trails lifespan? Are the construction plans optimised to minimise cost during building? Can the land manager and the community bear the long-term costs of maintaining a trail? The key challenge is balancing the costs of building and maintaining a trail with its long-term benefits. A well-planned trail should offer valuable experiences for users while being financially viable. This requires considering all economic factors – from construction to upkeep – while ensuring that stakeholders, including mountain bikers, local businesses, and the community, benefit. A sustainable management model is essential to achieve this balance. The economic component of trail construction is, as such, directly linked to the investment made in construction and maintenance. On the other hand, a trail can also generate income (for local communities), being involved in its management and promotion, supporting it with products, accommodation, or other goods and services that enrich the users experience, (IMBA 2017).

Economic sustainability can also mean to make a business model that will cover the cost of maintenance through income generation through defined income streams from either paid parking, paid lift service, municipality

financial support for maintenance, etc. Incorporating risk and liability management into economic sustainability planning ensures that resources are allocated effectively, safeguarding both the trail system and its users. By addressing these considerations comprehensively, trail managers can enhance the overall economic sustainability of their projects while providing a safe and enjoyable experience for trail users.

According to IMBA “Economic sustainability is an often-overlooked element of the long-term sustainability of a trail system. A trail system requires maintenance, and maintenance requires people. Having a plan to fund and staff the required level of maintenance is vital. Whether you plan to rely on volunteers, or utilize land manager staff, professional contractors, or some combination of the three, ongoing maintenance is key to ensuring that the user experience is consistent and positive. Trail users will not revisit a neglected trail, but rather ride other trails that are better maintained and meet their experience expectations. A commonly used planning metric is to expect to spend 3 -10% of the original construction budget annually for professional trail maintenance on natural surface singletrack trail systems with typical technical and flowy features, and 10-20% for bike parks and gravity trail systems” (IMBA, 2023).

There are also factors that can differentiate a trail or network of trails in terms of their economic sustainability, for example recreation and tourism. Whatever the scope, it is important to assess the sources of funding available for planning, building, and maintaining trails. The goal is to create a financially sustainable model that keeps the trail attractive and well-maintained over time, ensuring continued use and support from the community. For locally focused trails, community involvement is key to long-term success. Creating participatory models, such as trail associations, helps ensure sustainability. As Campbell (2021) notes, “Trail associations serve to mobilise the riding community by harnessing social capital and a willingness to contribute to trail maintenance.”

The value of volunteering for developing a sense of community in sports settings has previously been demonstrated (Cuskelly & O’Brien, 2013) and trail associations have an important role to play in developing sustainable mountain bike communities. In that sense, “integration of professional and voluntary trail builders should be encouraged and, where possible, trail associations and unofficial trails crews should contribute to the creation of the right trails in the right place” (Iversen, Kristensen & Arvidsen, 2023). If the trail or network of trails has a more touristic purpose, we can see a propensity for business, since it represents an opportunity to sell more products and services. The increased business opportunities rarely related to the actual trail use (except some privately owned “pay-to-ride” trail centres), but mainly various opportunities, such as: accommodation, transportation, mountain biking related services and products, or other sources of income. In this case, the planning, construction and maintenance of trails must take into account the economic potential of the region, its location and the tourist offer that complement its implementation, in the search for profitability and economic sustainability.

The awareness and desire to follow sustainable practices is increasing among consumers, which makes tourists take this into account when choosing a

tourist destination. A European concept that emerges supporting of sustainable tourism is the one of slow travel, which can be defined as the “visitor’s opportunity to become an integral part of the destination, while connecting with the community and the territory at a pace appropriate to the apprehension of the local culture” (Publituris – O Jornal da Indústria do Turismo, 2009, in Lima, 2021).

According to Popescu (2018), tourism makes one of the most important contributions to sustainable development due to its dynamism and growth, which directly impacts economic growth in regions and tourist destinations. The slow travel/tourism movement essentially focuses on the reciprocal return both for the tourist, through the experiences, and for the local community, who derive financial benefits from their local businesses, thus counteracting mass tourism, and aiding the sustainable development of a more specific market niche. In this way, Gunesh (2019) states that tourism companies should focus their marketing and publicity on the environmental concerns that underpin their business, so that these are perceived and acknowledged by the various stakeholders. This will lead the company towards an environmental and social balance, which will eventually also lead to an economic balance and profit generation. Mountain bike trail planners should consider these factors, especially in smaller regions where new trails can have a greater socio-economic impact. Unlike larger destinations with existing infrastructure, these areas may rely more on trails to boost local development. The mountain bike trail planner can also be aware of the experiences that the trail itself provides, encompassing the entire slow travel/tourism concept with the local surroundings, both in contact with nature and environmental resources, and in the promotion of social interaction with the local community.



Photo: Hallingdal Rides

2.1.3. SOCIAL SUSTAINABILITY

This is an important aspect that must be taken into account when planning, building and managing trails. Local communities should be involved from early stages, and in the management plan, in order to meet desired building results and user outcomes (experiences and associated benefits) integrated with local landowners and partners. Another social aspect relies on the users: overcrowded trails, trails with little use, trail users who feel “pushed out” by other users, and unauthorised routes, are problems that should be carefully studied during planning, construction and management phases, in order to prevent their occurrence.

If we consider the United Nations initiative for Sustainable Development – Agenda 2030, and its main objectives, we can see that the social dimension of sustainability is very much present in the various indicators that seek to achieve a more equal, diverse and equitable world. In short, the actions aim to improve people’s quality of life by reducing social inequalities, expanding rights and guaranteeing equal access to (mainly) primary services. The success of sustainable development from a social point of view benefits not only the most disadvantaged populations, but the entire population, in an attempt to reduce differences by bringing people closer together, in order to promote social cohesion and facilitate cultural identity (United Nations, 2015).

From the users point of view, the social sustainability in trail building aims for a trail, or a trail system, that prevents social conflicts between trail users, both mountain bikers and other user groups. A well-designed trail system creates enjoyable and challenging experiences, keeping users engaged and ensuring its long-term sustainability. “Sustainable trails are designed, constructed, and managed to accommodate their intended types, amounts, and seasons of use to provide high quality visitor experiences while protecting the trail infrastructure and adjacent natural resources” (Marion and Wimpey 2017).

In Guidelines for a Quality Trail Experience (2017), the International Mountain Bicycling Association (IMBA) discusses social sustainability and the challenges of designing trails that meet the diverse needs of mountain bikers.

“An integral part of mountain biking is balancing sustainability with challenge. Mountain bikers are constantly testing the limits of their skills and equipment. Challenging trails can provide a rider with numerous outcomes that can be realized in a variety of settings: a sense of excitement or exhilaration, progression, or an opportunity to test and develop their skills. For mountain bikers who are new to the sport, trails on the easier end of the spectrum provide an opportunity to develop their skills in a safe and predictable environment. For more advanced riders, challenging trails provide the opportunity to push their personal limits as well as those of their gear. Regardless of where a rider falls within this spectrum, when a trail is designed, planned, and managed to provide desired and challenging trail objectives, the rider’s opportunity to realize these targeted outcomes will be increased. The question is, though, how do you accommodate a range of mountain bikers who define challenges the same way yet seek dramatically different trail features to achieve a similar experience? As land managers and riders, we often hear both ends of the conversation: “We want sustainable trails but don’t dumb down what we already have” or “Those trails are insane, crazy, and impossible to ride.” In an era that has been defined by trail-building

principles like the Half Rule, 10 percent average grade, and contour trails, it can be easy to miss the mark when designing and building bike trails for the appropriate level of rider skill and challenge” (IMBA, 2017).

2.2. INCLUSION CONCEPT AND ITS DIMENSIONS

It is important to note that inclusion as a general concept implies aggregating, adding or encompassing someone within a group that they weren't part of, becoming an active part of it with decision-making considerations (Conceitos do Mundo, 2022). Although inclusion can be recognised as one of the main components of the social sustainability dimension, it will be highlighted in this report as a separate domain, because of its importance in contemporary society. “Inclusion is seen as a universal human right. The aim of inclusion is to embrace all people irrespective of race, gender, disability, medical or other need. It is about giving equal access and opportunities and getting rid of discrimination and intolerance (removal of barriers). It affects all aspects of public life” (Inclusion Me, 2024).

Inclusion can also be analysed in three areas of intervention which will be referred to independently: social, educational and labour.

2.2.1. SOCIAL INCLUSION

In general, it refers not only to economic and educational aspects, but also to political participation, cultural life, and social protection, with the aim of providing opportunities, rights and duties equally to all citizens. By definition, “Social inclusion is the process by which efforts are made to ensure equal opportunities – that everyone, regardless of their background, can reach their full potential in life. Such efforts include policies and actions that promote equal access to (public) services, as well as enable citizens participation in decision-making processes that affect their lives” (UN, Department of Economic and Social Affairs - Social Inclusion) reiterating the goal of the UN's 2030 Agenda: “The commitment to leave no one behind is among the defining features of the 2030 Agenda for Sustainable Development” (UNESCO, 2022).

2.2.2. EDUCATIONAL INCLUSION

Essentially concerns the pedagogical field, seeking to ensure that the school responds to an environment of diversity, regardless of social, political, cultural, or economic differences. As a basic assumption, the heterogeneity of students should not be an impediment to the school carrying out its educational work, since every educational institution should be able to identify the barriers that limit learning and propose alternatives to overcome them. This translates into an inclusive model of schooling, in which racial, cultural, social and even cognitive differences are not a discriminatory factor, but on the contrary, each student can learn in their own way and based on their own abilities/conditions.

2.2.3. LABOUR INCLUSION

It responds to the idea that work is a fundamental human right, and that people with physical or mental disabilities or other limiting conditions should not be excluded from the labour market if they have the necessary skills and abilities to do so. An inclusive labour model guarantees citizens, regardless of their personal challenges, the possibility of earning a living in a dignified and honest way. In this way, it protects them from exploitation circuits, the lure of criminal favours or addictions, and therefore also benefits society as a whole.

From the point of view of accessibility, we can see that "Inclusive design is about making places that everyone can use. The way places are designed affects our ability to move, see, hear, and communicate effectively. Inclusive design aims to remove the barriers that create undue effort and separation. It enables everyone to participate equally, confidently, and independently in everyday activities" (Inclusion Me, 2024).

With regard to the planning, construction and maintenance of trails, we must also consider the user's point of view, because in all phases we must take into account the different levels of inclusion mentioned above, in order to make it possible that, regardless of any limitation, everyone has the opportunity to integrate these structures.

2.3. INCLUSION IN MOUNTAIN BIKE TRAIL BUILDING

An inclusive approach: Mountain bike trail building must aim to make the mountain bike and trail building community more aware of giving equal access and opportunities where possible. As a trail builder or a trail building manager, it's important to reflect and understand inclusive design of trails to remove barriers that create limited access and opportunities for all kinds of people.

Inclusion in the trail building workplace: As a trail builder or trail builder manager, it is essential to foster an inclusive and respectful work environment by actively identifying and removing barriers that may contribute to an unsafe or unwelcoming atmosphere. This includes respecting colleagues' personal boundaries, promoting kindness, and remaining mindful of gender representation within the team. Additionally, it is crucial to comply with all applicable regulations and standards concerning both the physical and psychosocial work environment—whether at the local, regional, national, or international level. In this sense, according to the Women Trail Builders Research Report (Trail Builder Magazine, 2023), which examined women's participation in the trail building sector—focusing on the challenges they face and the opportunities for greater inclusion—there is still considerable progress to be made to create a more open and accessible industry for women. The report emphasizes the need for “affirmative actions, inclusive policies, and cultural shifts within organizations to foster more equitable and diverse participation in both trail construction and management”. In this context, communication plays a key role in improving media representation, enhancing female recruitment, and expanding women's leadership within the field. Strengthening these areas is essential for breaking down barriers in a sector that remains predominantly male-dominated, (Trail Builder Magazine, 2023).



Photo: MTB Adapt

Inclusive trails: An inclusive approach to trails and trail networks in mountain bike trail building must focus on how the trail system can be fun and inviting to as many users and user groups as possible at the same time. This is not an easy task, but if we narrow the task to reflection and understanding of the potential trail user's needs, then it becomes a little less complicated. It is vital to understand that the trails greatly influence the user experience. There can be more barriers than the actual trail design, for instance financial barriers if the trail systems are not for instance on public land with public access with no fees charged.

When planning, constructing, and maintaining mountain bike trails, it is essential to consider the broader community, beyond the riding community itself. Each local and regional context will have different user groups whose needs should be taken into account. This may include individuals with disabilities, underrepresented social groups, and organisations that support inclusive access to outdoor recreation. Engaging these stakeholders helps ensure that trails serve a diverse range of users and reflect the needs of the communities they are built in. Below are some examples of interventions in different areas of inclusion, with the aim of promoting the full and equal participation of all individuals in different contexts:

- in educational inclusion, with the possibility of setting up workshops, training programmes or training courses;
- in social inclusion, creating conditions of accessibility for anyone, regardless of their social status or economic condition;
- in labour inclusion, through policies to promote and encourage the hiring of services to create jobs in this area of mountain biking.

Finally, the use of mountain bike trails should also reflect the commitment of the local community and central governments, so that everyone can enjoy the trails, creating conditions for this to happen: accessibility, job opportunities and networking (partnerships between different organisations), cost subsidies, use free of charge or with reductions applied, sponsorship from private entities such as foundations or charitable associations, school or municipal educational projects that promote the settlement of these populations in the region to which they belong.

As demonstrated in the EU project “We Bike Together - Training and trail mapping in Europe”, there is a need to gather competences and knowledge on suitable trails in European countries, not just to be mapped, but also design trails suitable for disabled people that practise off-road cycling.

“This in turn is in line with specific objectives of European policies in the field of promoting voluntary activities in sport, together with social inclusion, equal opportunities and awareness of the importance of health-enhancing physical activity through increased participation in, and equal access to, sport for all”, (European Commission, 2018. We bike together – Training and trail mapping in Europe).

According to the EU project “BESiC” (Building Eco-Social Innovation and Inclusion through Cycling), whose main premise is to promote universal access to green, safe, accessible and inclusive spaces, as well as to reduce the adverse per capita environmental impact of cities, inclusion must be prioritised in order to achieve global sustainability, particularly for people with disabilities. One of the project’s main conclusions reveals the direct benefits of integrating regular physical activity for people with disabilities:

- **social benefits:** cycling is a relational sport, allowing people to meet and spend time together (with able-bodied friends too), reducing the risk for social exclusion and difficulties related to social relationships;
- **healthy benefits:** people with physical and/or sensory disabilities do not have many chances to practise sport and take advantage of its benefits on health; the use of special/proper equipment, together with trained accompanying volunteers, could facilitate the practice of handbike’s activities, (BESiC, 2025 - Building Eco-Social Innovation and Inclusion through Cycling. Erasmus+).



Photo: DMBinS

2.4. ADAPTIVE MOUNTAIN BIKING

New developments in technological advanced adaptive bikes are changing the opportunities for adaptive riders. Adaptive mountain bikes are three or four wheeled bicycles with or without electric motors that provide opportunity for riders – who may not otherwise ride a standard mountain bike due to physical, intellectual, neurological, and sensory abilities – to ride trails. These new bikes open a new dimension regarding inclusion in trail building, mainly concerning trail width, outslope, and narrow pinch points on the trail. Technical trail features' length and height compared with different wheelbase and ground clearance of mountain bikes and adaptive bikes makes this challenging for the trail builder (KOOTENAY ADAPTIVE SPORT ASSOCIATION. Adaptive Mountain Biking Trail Standards, 2020). In order to provide more detailed information about the trails, allowing for a better decision regarding the use of adapted trails, there are trail difficulty rating systems (e.g. Trail Difficulty Rating System, IMBA) that rate the technical difficulty of recreational trails, analysing the trail in terms of the following indicators: trail width, tread surface, average trail grade, maximum trail grade, natural obstacles and technical trail features (TTF).

The growing demand for information on this topic has led to the genesis of different entities that gather information on adapted bikes and mountain bike trails, in order to provide choices that meet the will or limitation of the practitioner. Some examples are: Bowhead (has become a reference in the sector of adaptative bikes), CatalystSports, Trailforks or even the Kootenay Adaptive Sport Association, that offers one of the most extensive resources currently available, providing detailed guidelines, programs, and tips on trail design for adaptive riders (KOOTENAY ADAPTIVE SPORT ASSOCIATION, 2025). This is a free resource for communities pushing for more inclusive access.

Typical characteristics of an adaptive mountain bike:

- Longer wheelbase - 1600mm - 2500mm as opposed to 1200mm for regular mountain bikes.
- Lower ground clearance - 6" / 15cm +/- 5cm
- High centre point - 15cm @ 80cm (can be lower and biased to one end or the other)
- Width - 80cm - 100cm
- Weight - 40kg plus

There are varying adaptive mountain bikes available around the world, each designed to meet a riders specific need. Readily established adaptive equipment includes: handcycles, recumbent leg-cycles, bucket Bikes, triride, wheelchair and tandem bikes. There are also many other types of adaptations, that allow riders to modify standard mountain bikes.

A **mountain tandem** (Fig.1) is a mountain bike that can be ridden by a visually impaired person if accompanied by a rider seating on the front seat; mountain tandems have two wheels, two seats and two handlebars. They can be equipped with suspension and pedal assist.



Fig.1. Mountain tandem

A **handbike** (Fig.2) is an adapted tricycle that can be ridden by a reduced mobility person; it has wide tires and can be equipped with suspensions and pedals; these guidelines do not apply to triride.



Fig.2. Handbike

A **mountain handbike** (Fig.3) three-wheel system is the reverse of most handcycles, with two wheels in the front and one in the rear. The body is also positioned nearly prone on the bike, and resting on a chest pad that is used to steer when the person is pedalling. It can also steer with the handlebars when not pedalling.



Fig.3. Mountain handbike

The **triride** (Fig.4) is small, compact and incredibly powerful. Attaching to the front of your frame by simple clamps, it is compatible with most models of wheelchairs.



Fig.4. Triride

Bearing in mind the different disabilities and the possibility of adapting bikes to specific needs and constraints, it is also important to mention some technical considerations to be taken into account when designing and building sustainable trails, particularly trails adapted for mountain bikes.

Trail considerations:

- Be aware riders may not be able to dismount the bike unaided.
- Riders need space to get on and off the bike—particular attention should be given at lift stations, parking lots, trail heads and stopping points on the trail.
- Riders with an existing disability may be more difficult to extract in the event of an accident - consider trail location with good emergency access by road in the design phase.
- Ensure fall zones account for riders at a different (prone) position than regular MTB.
- Riders may be strapped to their bikes.
- The lower eye line adjusts sight lines on the trail. Cut vegetation and back slopes accordingly (perspective: a 7-year-old shoes).
- Lower eye level influences trail signage positioning.
- Generally wider trails suit these mountain bikes better due to their wider track - this still gives rider line choice (rider experience).
- Generally shallow gradients suit these bikes, particularly on climbs although provided there is enough space to pass by it is possible for adapted bikes to be used on all difficulty levels of trail, depending on the rider's skill.

- Adapted bikes are generally wider and longer, take this into account when planning and building passing and stopping points along the trail (e.g.: tandem bikes allow cyclists to ride on single tracks, but narrow obstacles and U-turns can cause difficulties).
- On a bike with no pedals, it is not possible to advance the bicycle through pumping action. Consider this during the macro and micro design phases.
- Rider weight transfer is different to traditional bikes and can compromise grip in places (changing the heavy / light pressure points on the trail).
- Double front wheels can aid grip but also require enough space to have both wheels on a similar plane. It is more difficult for riders to push down on the front wheel to aid grip.
- Consider width and length implications and how they impact corner radius, turn width and berm transitions.
- Consider the width and length implications of the bike when designing / building in slope rollers and other trail features.
- Rollers, drops and protruding obstacles such as water bars, textured rock armouring or other TTFs need to account for a lower high centre point than a traditional bike.
- Airtime features (particularly take offs and landings) need to be longer to accommodate longer wheelbase to prevent frontal accidents. Shallower / longer transitions in take-offs makes jumps less 'kicky' (again due to wheelbase and lack of 'pull' by the rider).
- Potentially heavier weight of machine plus rider can mean more braking space is required to slow down, however this is often negated by increased tyre contact patches improving braking traction. This could potentially increase trail degradation in braking zones.
- Longer wheelbases require longer low points in grade reversals to negate the V 'g-out' in the centre of the drainage. 'Nike Swoosh' alignment of technical trail features and drainages will also result in 'g-outs' and increased trail wear.
- Riders newer to using the adapted bike or new to mountain biking can be prone to over braking to aid security and can struggle with fitness during activity. Ensure shallow / low gradients, long lines of sight (at their eye level) and frequent stopping and rest points are included in beginner adapted bike trails.
- Consider the addition of other sensory experiences along the trail to further stimulate and engage riders. Ensure these are not a distraction to the primary task of riding the bike.
- Curate and augment the rider experience at stopping points.

3. RESULTS - DIRT EUROPEAN TRAIL BUILDING SECTOR SURVEY

3.1. ABOUT THE SECTOR SURVEY

As part of the DIRT 2.0 project, a sectoral survey was carried out which addressed (Sector involvement, structures, and roles; Trail sector competencies; Sustainable trail knowledge and practice; Inclusive trail knowledge and practice; Certification preferences). For this report, only the questions relating to sustainability and inclusion will be analysed. The survey was distributed via software and was open between January and February 2024, with a total of 52 questions. The inclusion criteria required respondents to be actively involved in the mountain bike trail sector and to usually reside in a European country. In total, 152 respondents from twenty-one European countries answered the survey, which allowed for a good level of geographical coverage. The survey can be read, in full, at the following link:

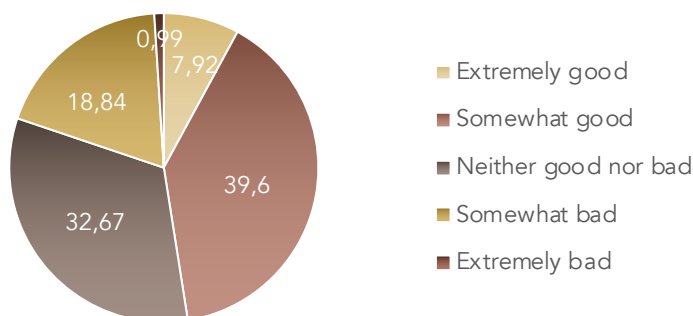
<https://www.imba-europe.org/wp-content/uploads/2024/09/DIRT-2.0-Trail-Sector-Survey-a4-09-24.pdf>

3.2. KEY FINDINGS: SUSTAINABILITY

How would you rate your knowledge of the topic of inclusive trail infrastructure?

Almost half (48%) of respondents believed their knowledge of sustainable trails to be good, or extremely good, while less than a fifth (20%) felt their knowledge was poor or extremely poor (Graphic 1).

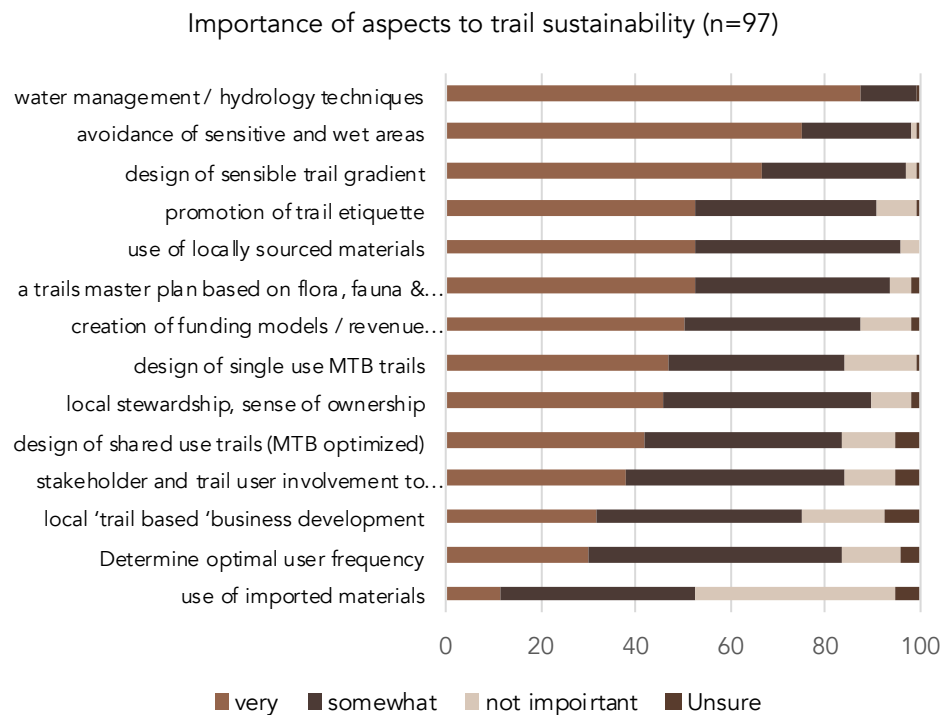
Perceived knowledge of sustainable trails (n=101)



Graphic 1. Self-rated knowledge of sustainable trails.

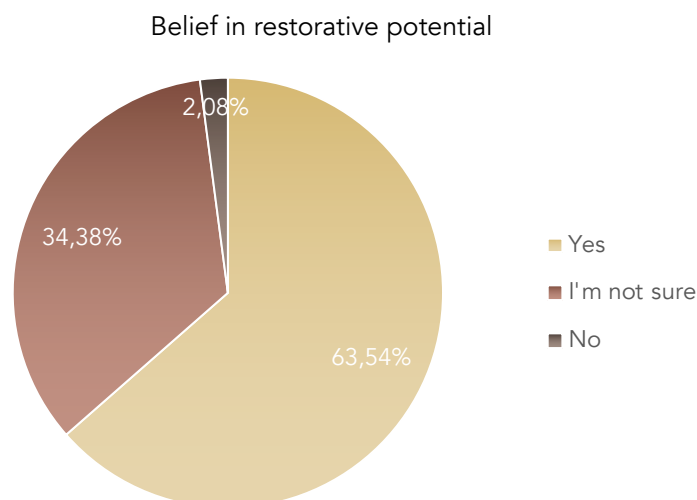
Do you associate the following topics with inclusive trail infrastructure?

A substantial majority of respondents reported that all possible response options were somewhat, or very much, related to sustainable trail infrastructure (Graphic 2). Safe and predictable trails were deemed to be the single most important element while accessible trailhead amenities were considered the least related to inclusive infrastructure. "Water management and hydrology techniques" were identified as the most important aspect for trail sustainability by the majority of respondents, highlighting the significance of this topic in the sustainable design, construction and maintenance of trails.



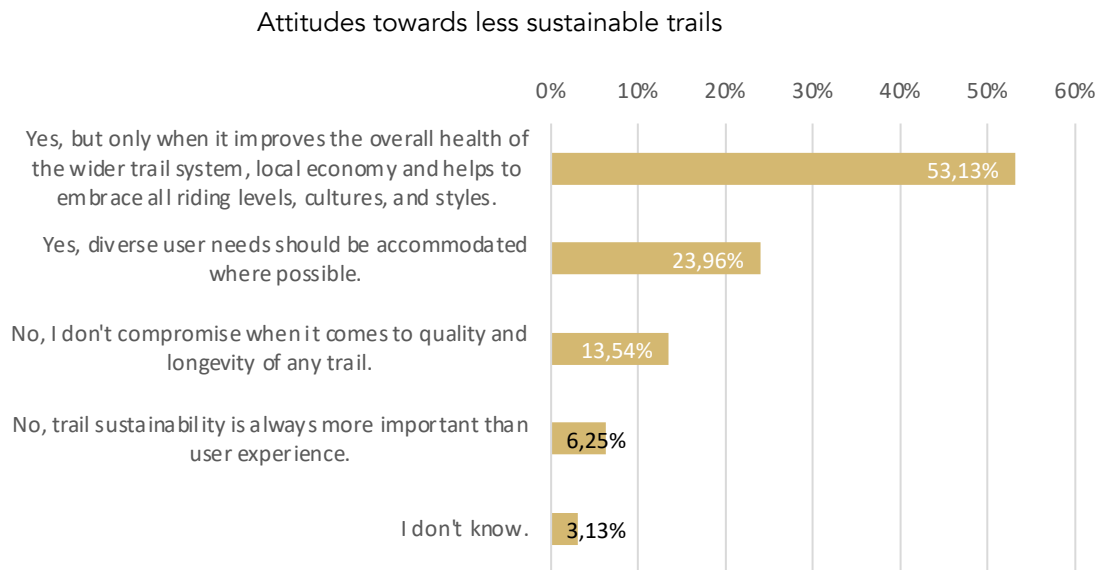
Graphic 2. Importance of aspects of trail sustainability.

Almost two thirds of respondents believe that new trail developments could go beyond reducing damage to actively support the restoration of the natural environment (Graphic 3).



Graphic 3. Belief in restorative trail construction.

Similarly, most respondents believe that some “less sustainable” or short-lived (e.g. fall line) trails might be developed but only where it helps to improve the overall health of a wider trail system, local economy or helps to embrace all riding styles (Graphic 4). Only one in five respondents believe that there is never a place for building a “less sustainable” trail.

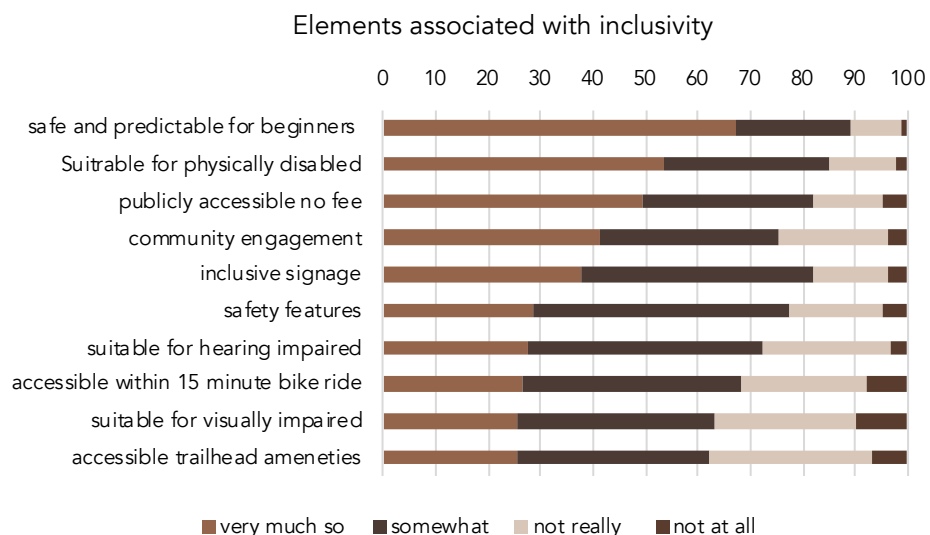


Graphic 4. Self-reported attitudes towards “less sustainable” trails.

3.3. KEY FINDINGS: INCLUSION

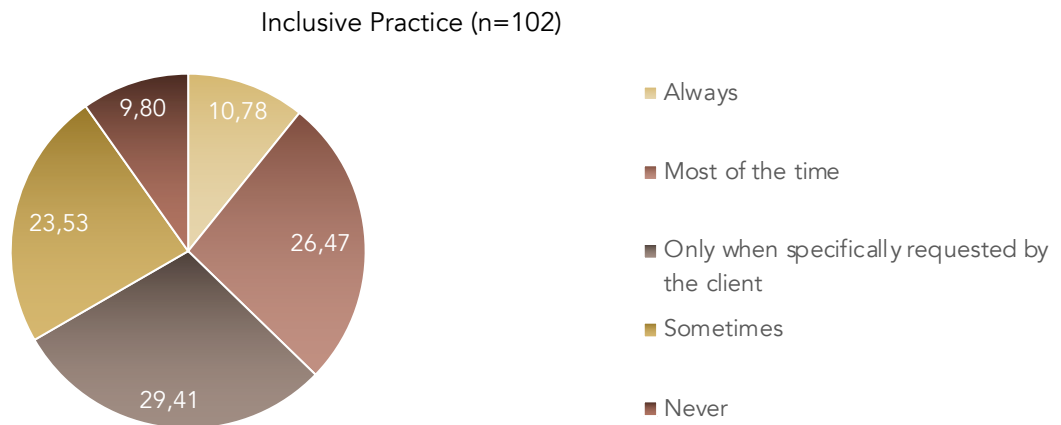
Most respondents believed that all possible elements of inclusivity were very much, or somewhat, associated with inclusive MTB Trails. The single most important element was deemed to be trails which are safe and predictable for beginners, while accessible trailhead amenities were reported as being the least important (Graphic 5).

To what extent is inclusive thinking already applied in the practice of developing new trails within your organization?



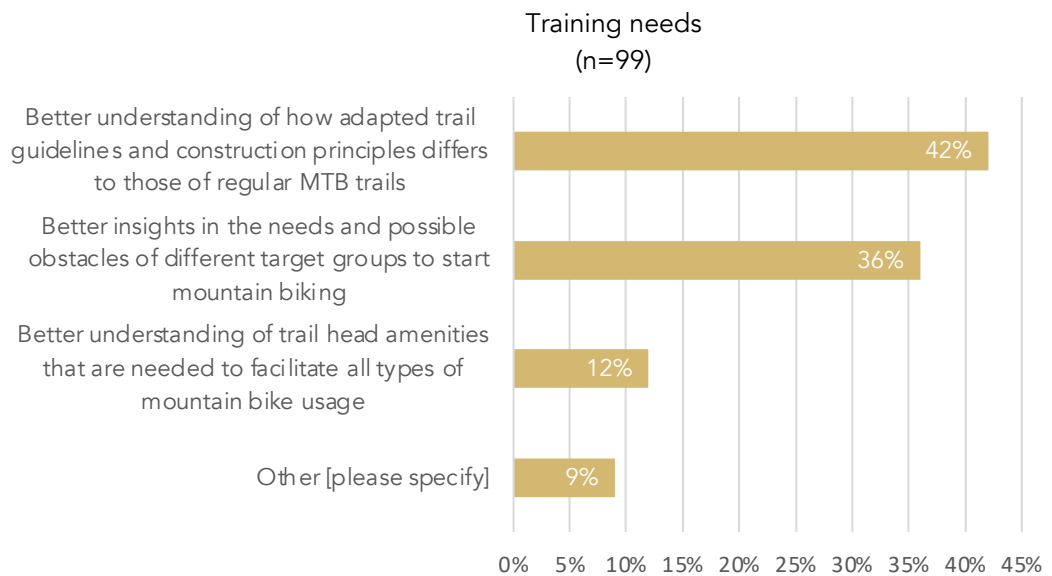
Graphic 5. Perceived associations between trail elements and inclusive MTB trails.

Only 10% of respondents believed that their organization “always” applied inclusive thinking when developing new trails although nearly a quarter felt that this applied “most of the time” (Graphic 6).



Graphic 6. Embedding of inclusive principles.

The greatest training need for inclusive MTB trail planning, design or construction was reported as relating to understanding and applying the principles of adapted trail guidelines (Graphic 7). There is also a strong requirement for training on the needs and barriers to promote participation of different target groups.



Graphic 7. Priority training needs in relation to the planning, design or construction of inclusive MTB trails.

3.4. SURVEY CONCLUSIONS

The key findings from the sustainability and inclusion sections were that:

- There is currently a reasonable level of perceived knowledge in the sector regarding sustainable trail design and the majority of respondents believe there is potential for trail developments to support regeneration.
- Despite awareness of the existence of various factors that determine the sustainability of trails, there is still a lack of technical and theoretical knowledge that would allow measures to be implemented that effectively reflect environmental, sustainability and inclusion concerns.
- The majority of respondents recognise the importance of inclusion in MTB trails, with an emphasis on creating safe and predictable trails for beginners, although accessible amenities at entry points are considered to be of lesser relevance. Although the application of inclusive thinking in organisations is often implemented, there are still variations in its consistency. The main need for training was identified as understanding and applying the guidelines adapted for planning and building inclusive trails, as well as a growing demand for training that addresses the barriers and needs of different target groups, with the aim of promoting greater participation in the practice of MTB.

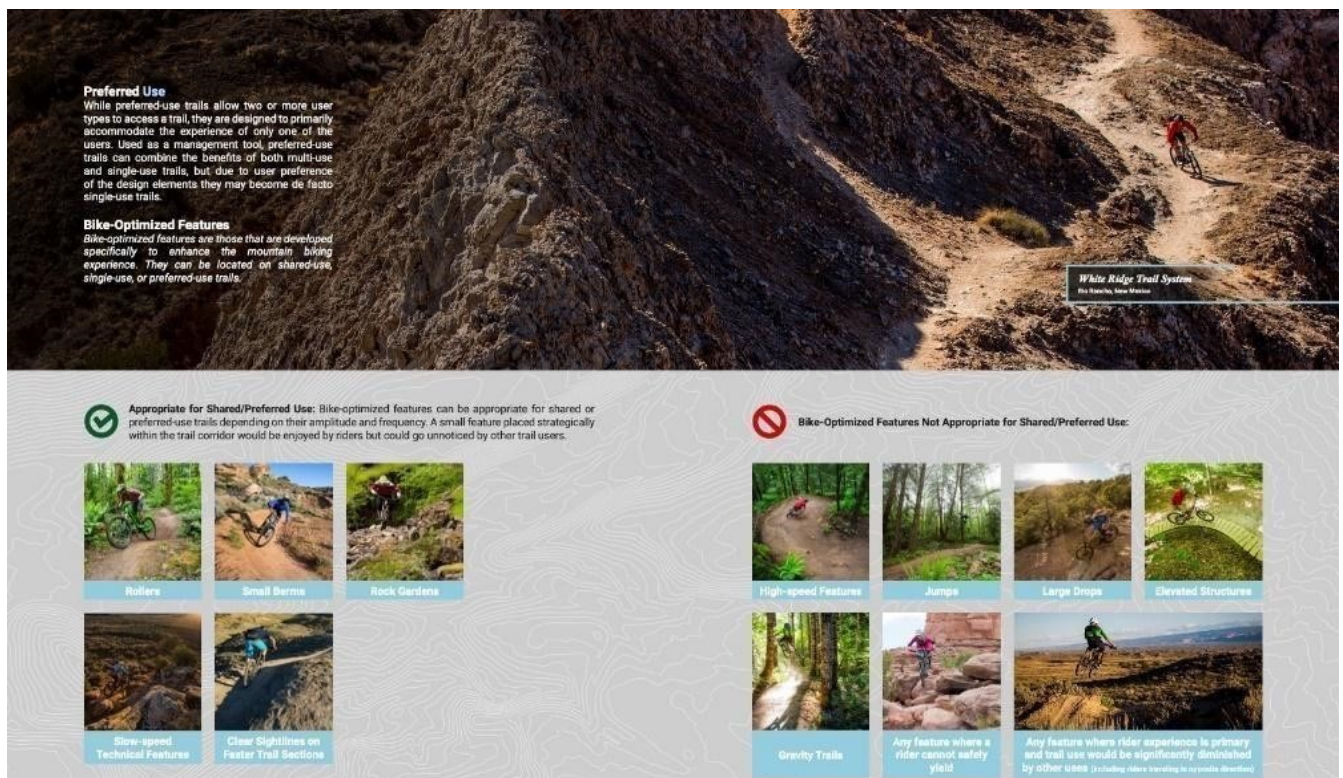


Photo: Magnus Grönberg

4. SHARED-USE AND SINGLE-USE

It is important to decide whether a trail should accommodate single-use or shared-use. Shared-use gives the broadest access of users, but can cause social interaction problems because of the mix of distinct speeds the different users travel by, mainly hikers and bikers. Single-use trails in a broader trail system mitigate user conflict by separating users into each of their trails. Economically, investing in shared-use trails can often be cheaper, since you only have to put in one trail to accommodate all users. However, if the shared-use trail generates user conflict, and in that case don't allow for the experience that the intended user requires, safety hazards or unproportionate degradation of the natural environment, then the trail can't be considered sustainable. In this context, it is essential to clearly identify the trails using labels, signs, or other communication strategies in order to mitigate the risk of social conflicts. It is also important to take access regulations into account, as several EU countries have rules or laws explicitly stating that trails should be used on a shared basis.

Also, there are certain types of trails and riding experiences that are not compatible with shared-use. IMBA (International Mountain Bicycling Association) provides valuable insight into shared-use and single-use trails in their Guidelines for a Quality Trail Experience book (IMBA, 2017). This document offers an excellent understanding of how to plan and manage trails to ensure all users—whether cyclists, hikers, or others—can enjoy a safe and positive experience. This approach considers multiple factors, including legal frameworks, which may define whether a trail is designated for shared or single-use.



Another concept that has emerged in the development of sustainable mountain bike trails, and which is also referenced in the Guidelines for a Quality Trail Experience book (IMBA, 2017), is that of having “the right trail in the right place”. This is essential in trail planning and natural space management, especially when it comes to sustainability and responsible land use. It reflects the idea that each type of trail should be located in an appropriate environment, taking into consideration the terrain’s characteristics, environmental impact, and user experience. This principle aims to ensure that trails are built in a way that respects local ecosystems while meeting the needs of users without causing harm to the environment. The core idea can be broken down into three categories:

Natural Trails – These should be located in more remote or wilderness areas, where human impact is minimized and ecosystems can be preserved. These trails are often found in areas that are more isolated or difficult to access, reducing pressure on fragile ecosystems.

Improved Trails – These are trails that can be adapted or modified according to the terrain and the users’ needs. Typically, these trails are found in more central or accessible areas and may include enhancements to the surface, such as compacting or paving. The goal of improved trails is to provide a more controlled experience, with less environmental impact than natural trails, but still respecting the surrounding environment.

Purpose-built Trails – These trails are designed for specific activities, such as urban spaces or those intended for specific sports like mountain biking or trail running. These trails are constructed in urbanized areas or regions with higher human concentration, where use is more intense. Purpose-built trails can have a design that maximizes the user experience while having stricter control over environmental impact.

This concept helps promote a balanced approach between utilizing spaces for outdoor activities and protecting our natural resources. In the context of mountain biking, it can be seen in how trails are distributed across different landscapes and how they are designed to cater to both the needs of practitioners and the sustainability of ecosystems. There are effective examples of this concept all over Europe, for example:

Swiss Alps, High Mountain Trails: Mountain biking trails at high altitudes are limited to less sensitive areas, while the more technical and challenging trails are found in mountain terrain that can be maintained without major impacts on the environment.



Photo: Swiss Tourism, 2025 - MTB Trails

Forêts de Fontainebleau, France: Mountain bike trails are carefully located to avoid impacting on sensitive forest areas and rock formations that are protected. There is a significant effort to separate mountain bike trails from other types of land use, such as hiking trails and natural wildlife habitats.



Photo: Office de Tourisme de Fontainebleau, 2025. Fontainebleau MTB Trails

Mountain Bike Trails in the UK, Specific Trail Networks: In the UK, an example of the application of this concept can be seen in the Forest of Dean region in England, where there is a network of specific mountain bike trails, such as the Freeminers Trail. The forest has been designated as a conservation area and, within this space, the mountain bike trails are carefully designed to minimise damage to the soil and vegetation. More technical trails are positioned in areas where the environmental impact is lower and the routes are made to fit the terrain and the natural characteristics of the forest.



Photo: SMBUK. 2025. Forest of Dean MTB Trail

Dolomites region, Italy: High-difficulty trails are built in the rockiest and steepest areas, while more accessible trails for beginners and families are found in the flatter regions and around the villages. Preserving local biodiversity and adapting to terrain conditions are priorities when planning these trails.



Photo: Dolomiti Superski 2025, Dolomiti Superski MTB Trails.

Mountain Bike Trails de L'Albera Region, Spain: In Spain, in the Catalonia region, the concept is also applied in areas such as L'Albera, where a system of mountain bike trails is designed to explore the local landscapes without affecting the areas of greatest environmental value, such as conservation zones and areas of dense forest. Trails of different levels of difficulty are built in specific regions to ensure that the impact on the environment is minimised and that the rider's experience is optimised, as in the following example - "... Towards La Jonquera, the route becomes quieter and traffic-free. The only drawback is that the pedalling is a little more difficult due to the steep slopes, alternating with small climbs. After 50 metres of stony paths, you reach a flat, level, rocky road".



Photo: Tourism Agency of Catalonia, 2025. Région de VTT de L'Albera.

Trails in Scotland, National Parks and Conservation Areas: In national parks such as the Cairngorms and Loch Lomond & The Trossachs, mountain bike trails are strategically located to ensure that the impact on the natural landscape and local species is reduced. Trails are limited to areas that can support continuous bicycle use without significant degradation of the soil or sensitive landscapes. These areas are frequently monitored and, where necessary, trails are adjusted or new paths created to balance human use and preservation. Information about the trails is also available online with warnings about shared circulation, “You can explore the multi-use trails within the National Park in so many ways, as they have been designed for walkers, cyclists, horse riders and adaptive riders. Whether you’re using an e-bike, child trailer, or simply enjoying nature, share the space responsibly for a safe and enjoyable experience”.



Photo: Cairngorms National Park Authority & Loch Lomond & The Trossachs National Park Authority, 2025.

5. IMPLICATIONS FOR TRAIL BUILDER COMPETENCIES

DIRTT has established three core competency groups—Mountain Biking in Society, Mountain Bike Trail Design and Management, and Mountain Bike Trail Construction and Maintenance—based on empirical evidence and industry collaboration. These groups form the foundation for all DIRTT courses, educational programs, and certifications. The standardized framework ensures consistency in trail-building training across Europe, aligning educational offerings with certification standards and preparing learners for certification while maintaining curriculum coherence.

In line with this approach, ‘learning outcomes’ are defined as statements outlining what a learner knows, understands, and can do after completing a learning process. These outcomes are described in terms of knowledge, skills, and responsibility. The European Qualifications Framework (EQF), which consists of 8 levels, provides descriptors for each level, indicating the relevant competence. The DIRTT2.0 Trail Builder Competence Framework aligns with EQF levels 4 and 5, while also incorporating levels 3 and 6 to offer a clearer progression of skills.

To ensure that the DIRTT educational framework addresses key issues such as sustainability and inclusion, a comparison matrix was developed to evaluate how the learning outcomes integrate these themes. This analysis focused on a quantitative approach, relating the 16 learning outcomes per level to the dimensions of sustainability and inclusion identified in the report, thus providing insights into how these competencies contribute to a broader educational and ethical framework.

	Environmental sustainability	Economical sustainability	Social sustainability	Inclusion
1. Mountain biking in society	13	15	16	16
2. Design & management	8	11	13	13
3. Construction & maintenance	16	10	12	12

This analysis confirms that sustainability considerations are embedded across the learning outcomes in the competency framework. However, the term ‘sustainability’ often appears in a broad sense without explicitly distinguishing between its environmental, economic, social, or cultural dimensions. Whether a specific dimension is addressed depends on the context of each learning outcome.

In contrast, inclusion is less consistently represented across the framework. To ensure that inclusion is adequately covered, specific learning outcomes can be developed for this dimension, particularly at EQF levels 4 and 5. This would provide a clearer and more structured approach to addressing inclusion within the competency framework.

The development of this report has made it possible to identify some gaps/weaknesses in DIRT's competency framework, namely in the formulation of appropriate learning outcomes for the following questions:

- Adaptive mountain bike trail guidelines
- Inclusion in the workspace
- Cultural sustainability
- Water management

In order to integrate the most relevant aspects of sustainability and inclusion, taking into account the indicator to which it refers, as well as the specific dimension, new learning outcomes have been created and others reformulated. Here are some examples:

Mountain biking in society

- New "sustainability and inclusion" topic was created, with specific learning outcomes;

Design & management

- Reformulation of learning outcomes, in line with the idea of adding inclusion and fostering inclusive practices;

Construction & maintenance

- A new topic "water management" has been created, with specific learning outcomes;
- Reformulation of learning outcomes to ensure labour inclusion in Construction and Maintenance indicator;

This report made it possible to identify the dimensions of sustainability and to mention inclusion as another differentiating factor, particularly in its social, educational and employment dimensions. The creation of new and reformulation of other learning outcomes adds value to the competence framework, bringing the trail builder or trail building manager curriculum into line with current standards and emerging concerns, with the aim of making mountain bike trails increasingly sustainable and inclusive.



Photo: trailtools.eu

6. SUMMARY

After discussing the theoretical concepts of the sustainability dimensions, and confirming the relevance on the topic of inclusion, we can retain that both are inseparable and should be part of the decision-making process of every trail project. We also see the need to consider a more holistic approach, inserting the concept of culture as an integral part of sustainable development, since there are various values, beliefs and norms that are specific to a particular group, place or region, which influence social behaviour in relation to the environment in which it is inserted.

This report also reviews the Sustainable Development Goals (SDGs) set out in the United Nations Agenda to Change the World by 2030, which constitute a universal 'call to action'. The Agenda's SDGs aim, not only to achieve sustainable development in its three dimensions - economic, social and environmental - but also to promote peaceful, just and inclusive societies. The 17 goals are interlinked and, as such, they must be understood by all stakeholders within the framework of a collaborative partnership (United Nations, 2015).

Sustainability must be a central principle in mountain bike trail construction. The planning, design, construction, and maintenance of trails should consider sustainability in its environmental, economic, and social dimensions, while also integrating inclusion from social, educational, and labour perspectives. Ensuring long-term sustainability requires trails to reflect the cultural context of the communities they serve, adapting to local values and needs. There are several organisations, such as IMBA Europe and their national branches, that provide resources, knowledge and information on building sustainable and inclusive mountain bike trails, addressing the environmental and social issues involved. However, according to Campbell, 2024, "It is still necessary to consider all aspects of sustainability to ensure an informed decision-making process. To facilitate this process, it is necessary to develop frameworks that guide the decision-making process."

We have learned that whilst there have been attempts to support an informed decision making process, there remains the need for a detailed framework which considers both global trends in mountain biking and also the local contexts as detailed by Campell, 2024: *'Only through an integrated approach which measures multiple variables longitudinally, including local geomorphic conditions, trail characteristics (e.g., grade, slope alignment, surface materials), weather conditions, ground and soil conditions, usage (e.g. volume, frequency, and patterns of use) rider behaviours (e.g., riding styles, braking technique, adherence to the trail) and considers the interaction between them can we can properly establish the environmental impact of mountain bike trail use within local contexts.'*

We have found that an inclusive approach to mountain bike trail construction should focus on how the trail system or trail network with varying levels of difficulty can be fun and inviting for as many users as possible, while still being safe and predictable for beginners, suitable for users with physical disabilities and accessible to the public for free.

We learned that it is necessary to reflect and understand the needs of potential trail users, not only on the trail, but also in the facilities at starting points or access points. It is vital to understand that the trail greatly influences the user experience. We learned that inclusion is about people, and the trail builder or construction manager needs to consider the inclusion of different types of users in all aspects of workplace design, construction, maintenance and management. We learned that existing trails are often not accessible to people with physical disabilities on adapted mountain bikes. This aspect of trail building is worth considering in greater depth in the future, as many trails require minimal considerations and adjustments to include adaptive mountain biking. We also learned that the trail construction sector must coordinate with product development in the adapted bicycle sector. Innovations in product design in this sector will likely result in equipment that will require fewer band design adjustments than current offerings require. We also learned that trail builders have identified a considerable need for training in the field of adaptive trail construction.



Photo: DMBinS

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