

## **USING MULTI-CRITERIA DECISION-MAKING TO ASSESS THE IMPORTANCE OF HUMAN CAPITAL IN MEETING THE GOALS AND OBJECTIVES OF SUSTAINABLE DEVELOPMENT: AN APPLICATION OF THE ANALYTIC HIERARCHY PROCESS**

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The concept of human capital continues to evolve and it has gained momentum in the process. Besides its impact on the economic growth of business and entire societies, human capital has emerged as a critical area of performance in achieving the goals and objectives of sustainable development. Following a brief historical background and a description of its evolution, the role of human capital in meeting the goals and objectives of sustainability is examined. A simulated case using a multi-criteria decision-making (MCDM) method known as the Analytic Hierarchy Process (AHP) further explores the importance or relevance of human capital in financial institutions. Research demonstrates the evolution of human capital as well as its increasing coordinating and supporting role in achieving social progress, economic growth, and environmental protection. To better manage and assess the role of human capital, we present a set of resources for the identification and selection of criteria and indicators as well as structure and scientific-based options that allow the effective engagement and participation of stakeholders to assess the relative and absolute importance or relevance of human capital within the concept of sustainable development. While challenges remain to fully understand the role of human capital in the sustainability environment, research outcomes demonstrate the progress already made.

**Keywords:** sustainability assessment; criteria and indicators; multi-criteria decision-making

### **1. Brief overview of human capital evolution: Embedding human capital into the concept of sustainability**

The evolution of the term ‘human capital’ can be discussed using three major eras: early beginnings, mid-twentieth century, and contemporary or modern. The early beginnings era was led by the first economist to theorize about capitalism, Adam Smith. The mid-twentieth century era brought widespread popularity to the term human capital as macroeconomics and Nobel Prize winners Theodore Schultz and Gary Becker became widely known and influential. More contemporary or modern conceptions of human capital make a distinction between different categories (e.g., general human capital, specific skills).

Many economists and non-economists have considered human beings or their skills as capital throughout the evolution of the idea of human capital. Most of the well-known names in the history of economic thought neither attempted an evaluation of human capital nor employed the concept for any specific purpose (Kiker, 1966). However, the connection between humans and their skills and economic growth and productivity has been recognized since the first attempts to define the term capital.

Adam Smith did not specifically define the term capital, but included the skills and useful abilities of human beings in his category of fixed capital (Kiker, 1966). Smith's writings about capital discussed in part 'the acquired and useful abilities of all the inhabitants or members of society'. According to Smith, the concept of "fixed capital" includes machines, land improvements, and buildings but should also consider the acquired and useful abilities of all the inhabitants or members of society. "The acquisition of such talents, by the maintenance of the acquirer during his education, study, or apprenticeship, always costs a real expense, which is a capital fixed and realized, as it were, in his person" (Smith, 1776, p. 282). Although Adam Smith laid the foundation for the concept of human capital back in 1776, by including human capacities in the notion of capital stock, the idea of human capital only started to gain significance in the 1950s and 1960s. To highlight the importance of human capital, some have linked education and training with healthy national economies and economic growth (Akintoye & Adidu, 2008) whereas others have emphasized the critical role of human resources in the wealth of nations and the active role of human beings in building economic, social, and political organizations, and promoting national development (Harbison, 1973). Friedrich List, Johann von Thünen, Irving Fisher, and others recognized the role of incorporating human beings in the concept of human capital; however, the concept was not universally accepted at the time (Savvides & Stengos, 2008). For instance, Alfred Marshall considered the idea of including human beings in the concept of capital 'unrealistic' because human beings are not marketable. The realization of the economic significance of human capital in the late 1950s and early 1960s was led by Gary Becker and Theodore Schultz. Schultz argued that the best form of investing in human capital is by educating human beings which results in "increases in national income and the 'rate of return' to the decision to invest in education" (Savvides & Stengos, 2008, p.15). Weisbrod (1961) built on Schultz's findings to further the concept of human capital. Public health, highway construction and flood control policies, population and immigration policies, and educational and vocational rehabilitation policies were the main reasons that Weisbrod formulated a calculation for a capital value for people as productive assets in monetary value (Savvides & Stengos, 2008). The interest in human capital during the mid-twentieth century era concluded with the publication of a special issue of the *Journal of Political Economy*. The special issue drew attention to how investment in human capital can provide answers in the following three areas: personal distribution of income, economic growth, and structure of earning.

The earliest interpretation of capital given centuries ago included the following four types of fixed capital: useful machinery, profitable buildings, improvement of land, and acquired and useful abilities of all the inhabitants or members of the society (Smith, 1776). However, "the rediscovery of human capital in the modern literature is associated with the efforts of analysts to understand the growth over time in labor productivity in the

U.S. economy” (Schuh, 2002, p. 76). Nelson and Phelps (1966) acknowledged human capital as a growth-generating factor. Mankiw et al. (1992) included human capital in neo-classical economic growth models and Benhabib and Spiegel (1994) considered the concept as part of the productivity growth nexus. The importance of human resource capital (particularly education) as a source of economic growth started to gain prominence in the second half of the twentieth century (Tisdell, 2000). Previous neoclassical models for economic growth emphasized quantities of human-made capital and labor whereas classical models considered factors such as natural resources and technological progress. Instead of attributing economic growth to increases in the quantity of capital and labor, an analysis of the sources of economic growth found that technological progress and education have a central role in improvements in the productive quality of human-made capital and labor (Denison, 1962). While education continued to be part of the set of contributors to economic growth, new theories of growth developed years later included other factors such as technical knowledge, economies of agglomeration and scale.

The latest evolution of the concept of human capital departs from the relationship between human capital and economic growth and addresses the nexus of economic growth and sustainability. The relationship between human capital and sustainability has only gathered attention and been addressed by scholars in the last few years. More recent studies use the term capital to include all forms of assets and capabilities - natural, biological, financial and human - that can be connected to and used for sustainable development (Slaus & Jacobs, 2011). Natural, biological, social, technological, financial, and cultural are all forms of capital included in sustainability studies (Slaus & Jacobs, 2011). Furthermore, the complex interconnection and interdependent characteristics of sustainability require a close analysis of the interaction among the various types of capital. Farčnick & Istenič (2020) identified two lines of research in the area of sustainable production or sustainable economic growth and human capital; the first well-researched area focuses on human capital and economic growth whereas economic growth and sustainability have been addressed only recently. The problem of sustainability has now evolved to the stage where it endangers not only human life but threatens to undermine the natural capital on which human civilization is based. “The sustainability of human capital is interwoven with the sustainability of all other forms of capital” (Slaus & Jacobs, 2011, p. 99). The often-cited model of strong and weak sustainability has a distinctive role in human capital. “Strong sustainability requires that both natural and human-made capital have to be maintained, while weak sustainability holds that utility of the sum of all capitals has to be maintained for future generations” (Slaus & Jacobs, 2011, p. 106). Ugnich et. al. (2021) indicate that “sustainable development implies a constant growth in the well-being of people in a quality environment.” But, the transition to sustainable development poses serious challenges for all components of the socio-economic structure of society, and a person here appears as a key subject of sustainable development. People must have the knowledge, skills, and tools, and be well-informed as well as feel supported to achieve the expected sustainability vision, goals and objectives.

## **2. Defining human capital: The challenge of quantifying an evolving concept**

The first known use of the term human capital can be traced back to 1799 and it is defined as “the skills, knowledge, and qualifications of a person, group, or workforce considered as economic assets” (Merriam-Webster, n.d.). Another formal definition given by the Oxford English Dictionary indicates that human capital refers to “the skills the labor force possesses and is regarded as a resource or asset.” Goldin (2016) adds “it encompasses the notion that there are investments in people (e.g., education, training, health) and that these investments increase an individual’s productivity” (p. 56).

Although scientific literature often goes back to Adam Smith to refer to the origins of the term human capital, work in the area of economics points to a formal use of the term by Irving Fisher in 1897 (Goldin, 2016). Adam Smith identified four types of fixed capital: useful machines and instruments of trade; building as the means of procuring revenue; improvements of land; and the acquired and useful abilities of all the inhabitants or members of the society. The fourth fixed capital refers to Smith’s (1776) interpretation of human capital, his writings state:

The acquisition of such talents, by the maintenance of the acquirer during his education, study, or apprenticeship, always costs a real expense, which is a capital fixed and realized, as it were, in his person. Those talents, as they make a part of his fortune, so do they likewise of that of the society to which he belongs. The improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labour, and which, though it costs a certain expense, repays that expense with a profit. (p. 282)

By the second era in the evolution of the term, the mid-twentieth century, a recognizable formal discussion on human capital was provided by Arthur Cecil Pigou. Referring to the term human capital, he wrote (1928):

There is such a thing as investment in human capital as well as investment in material capital. So soon as this is recognised, the distinction between economy in consumption and economy in investment becomes blurred. For, up to a point, consumption is investment in personal productive capacity. This is especially important in connection with children: to reduce unduly expenditure on their consumption may greatly lower their efficiency in after-life. Even for adults, after we have descended a certain distance along the scale of wealth, so that we are beyond the region of luxuries and "unnecessary" comforts, a check to personal consumption is also a check to investment. (p. 29)

Years later, Schultz (1962) provided a historical overview of the term human capital focusing on two major components: education and training. Human capital is then “the stock of productive skills, talents, health, and expertise of the labor force, just as physical capital is the stock of plant, equipment, machines, and tools” (Goldin, 2016, p. 83). More contemporary definitions of human capital can be found in reputable, reliable and worldwide organizations such as the Organization for Economic Co-operation and Development (OECD), the World Bank, and the World Economic Forum:

Human capital can be broadly defined as the stock of knowledge, skills and other personal characteristics embodied in people that helps them to be productive. Pursuing formal education (early childhood, formal school system, adult training programmes) but also informal and on-the-job learning and work experience all represent investment in human capital. (OECD, n.d.).

Human capital consists of the knowledge, skills, and health that people invest in and accumulate throughout their lives, enabling them to realize their potential as productive members of society. Investing in people through nutrition, health care, quality education, jobs and skills helps develop human capital, and this is key to ending extreme poverty and creating more inclusive societies (The World Bank, 2022).

Human capital—the capabilities and skills of individuals and populations—is a key driver of economic prosperity and productivity. It can be developed by ensuring individuals are able to sustain good health, and they are in possession of in-demand skills and capabilities. The value of human capital is realized in the labour market through productive employment, and it is developed through education during the first two decades of an individual’s life as well as through mid-career training investments (World Economic Forum, 2020).

The definition of human capital can be adapted to fit narrower views of a project or business. Organizations often focus on employee experience and educational achievement to measure human capital and the economic value of their workforce. Furthermore, the term human capital is either used in a narrow sense with reference to the innate talents, abilities, skills and acquired knowledge of individual human beings or is broadened to include the entire spectrum of an individual’s intellectual, physical and psychological abilities (Slaus & Jacobs, 2011). Other definitions of human capital link the assets (i.e., employees) to the economy and economic growth. Porreca (2020) refers to human capital as the contribution of the individual worker to the output of an economy, whereas Slaus and Jacobs (2011) use the term human capital to refer to human beings as one of the means and contributing factors in economic growth and social development.

The evolution of the human capital concept has been influenced by contemporary developments such as sustainability. Porreca (2020) indicates that economic growth and improvements in social well-being, are tied to the concept of human capital, whereas Farčnick and Istenič (2020) link human capital to sustainable consumption of production inputs, especially energy, as well as to a decreasing carbon footprint of a specific economic unit/country. Moreover, the connection between population and the development of human capital has become evident to the extent that the central determinant of resource productivity and sustainability is human capital including social capital (Slaus & Jacobs, 2011). Nonetheless, “the human factor and its influence on development in general and more particularly on sustainable development can be analyzed from many points of view” (Ciuhu, 2016, p. 43). Similar to sustainability, the human capital concept is characterized by the constant evolution of its definition (some areas of assessment are highly subjective) and the need for adaptation is embedded in it. All three characteristics are determining factors to measure its relevance (i.e., weight)

within the concept of sustainable development. “You can’t manage what you can’t measure” or “if you can’t measure it, you can’t improve it” are quotes often used to highlight the criticality of setting measurable and tangible goals and objectives. For sustainability and human capital, the successful design and implementation of goals and objectives is an expansion of the ability to define the concepts.

### **3. Identifying and selecting indicators of human capital to measure progress toward sustainability**

The use of indicators and composite indices are some of the most widely used instruments to measure, track, manage, and improve sustainability performance. Nevertheless, indicators and composite indices must be used with caution because there is an increasing focus on the various factors included in index scores to measure sustainability instead of examining the underlying factors that provide a better understanding of these index scores (Porreca, 2020). The starting point of the identification and selection processes of indicators is the definition of the term human capital. The concept of human capital not only continues to evolve but is also directly influenced by the principles of sustainability. Based on the principles of sustainable development created by the UN Commission in 1987, the concept of sustainable development includes the following three main areas of performance also known as pillars or dimensions: natural environment, economy and society. While the definition of sustainable development provided in *Our Common Future* report also known as the Brundtland Report has been widely criticized, it still provides a convenient conceptual departing point. Throughout the years, countless frameworks along with graphic representations of sustainability have been proposed. Figure 1 includes some of the most common graphic representations of sustainability. Either by conceptual frameworks or graphic representations of sustainability, the integration of two or more areas of performance (i.e., pillars or dimensions) to capture the different facets of sustainable development is widely recognized and accepted.

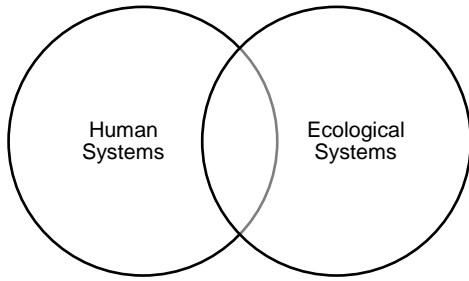
Because human capital is embedded in the social dimension of sustainability, the dimensions included in the concept of sustainable development have an essential role in determining the importance (i.e., weight) of human capital in achieving the desired overall performance (i.e., goal and objectives). Farčnick and Istenič (2020) concluded that human capital and awareness of its importance play a critical role in achieving the goal and objectives of sustainable development. From its very early beginning, sustainability has included two or more areas of performance (i.e., dimensions or pillars). Figure 1(h) illustrates ‘the egg of well-being’ in which people are represented as immersed in the white of ecosystems whereas Figure 1(d) illustrates the most common representation of sustainability in a Venn diagram in which the social, economic, and environmental pillars are interconnected. While culture and policy are other pillars often found in frameworks and definitions of sustainability, others propose that the concept of sustainable development must include a broader range of economic, ecological, political, technological, and social areas of performance (Slaus & Jacobs, 2011).

Human capital has become an asset for organizations to achieve their sustainability goals, objectives and vision. Therefore, human capital must be associated with metrics in order to measure and manage progress toward the desired target(s). In the Five Capitals Model

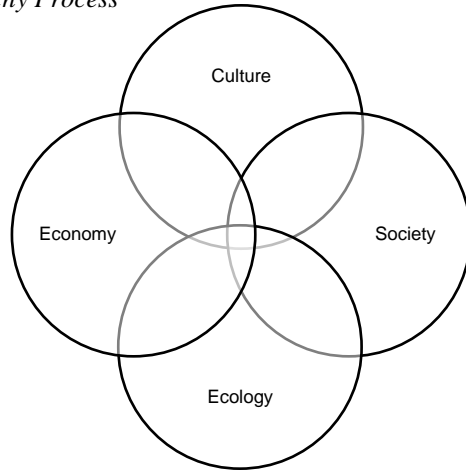
(FCM) which is graphically represented in Figure 1(1), Porritt (2005) includes the following five types of sustainable capital: manufactured, financial, social, human, and natural. The FCM considers people's knowledge, motivation, health, and skills as primary factors for productive work; by nurturing and developing those primary factors, the economy is set to flourish through training and education (Porritt, 2005). Slaus and Jacobs (2011) include areas such as knowledge, skills, attitudes, capacities of individual, social and cultural endowments of the collectives, including the capacity for discovery, invention, innovation and resourcefulness within the concept of human capital. From the assessment standpoint, human capital is difficult to quantify precisely and there is not a fixed set of criteria to analyze human capital; however, some of the most common factors included in human capital are education, knowledge, specific skills, and health. From the environmental, social and governance (ESG) standpoint, human capital can be evaluated across areas including well-being, diversity, equity and inclusion (DEI), employee experience, and operational excellence. Bremen et al. (2021) write:

Human capital metrics include workforce profile, pay, benefits, careers, hiring, retention, productivity, wellbeing and culture. Governance and ethical metrics related to human capital include whistle-blower policies, unethical behavior tied to monetary losses, dismissal and incentives against excessive risk-taking. There are also several human capital management-related ESG metrics, including employee productivity, pay gaps, high-performance employee experience, and equitable access to reskilling and upskilling programs. There are quantitative metrics, including pay-equity ratios, diversity and representation targets, the retention rate of top talent, investment in employee upskilling, return on work, and the total cost of work. And there are metrics that cut across categories, such as benefit claims ratio and total workforce value.

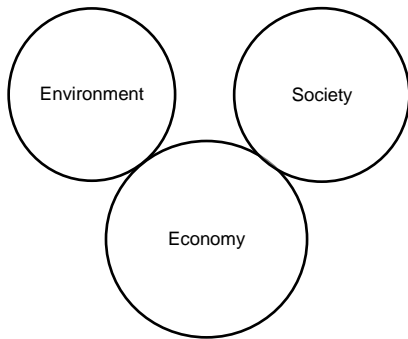
Human capital can be viewed as a stock of knowledge and skills that have a direct impact on how we produce and consume goods. Knowledge and skills can be used as instruments for optimizing management, operational, and production processes and can result in the reduction of negative environmental impacts in the form of GHG emissions, exploitation of natural resources, energy and water consumption levels, and waste. Porreca (2020) indicates that human capital is the sum of factors related to educational, health, and societal outcomes that individuals experience and bring into the workplace. Salim et al. (2017) include various factors to measure human capital such as average years of formal education, the portion of people who hold at least a secondary qualification or a tertiary degree, present value of human capital stock per capita, and the present value of human capital stock per capita in the labor force. Qualities within the concept of human capital most commonly found in the literature are education, technical or on-the-job training, health, mental and emotional well-being, punctuality, problem-solving, people management, and communication skills.



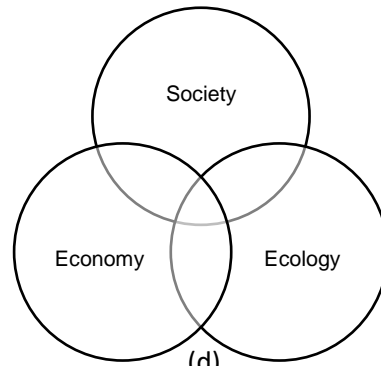
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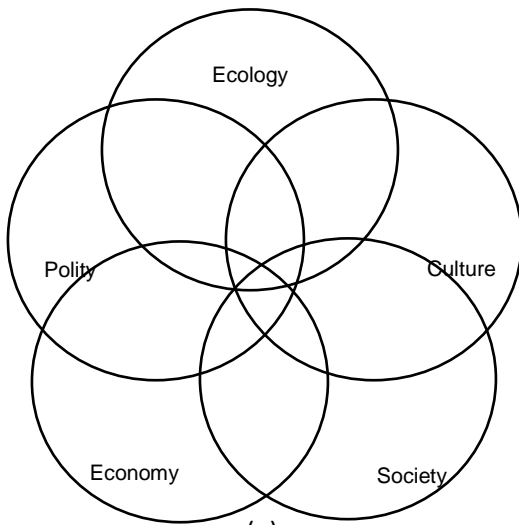
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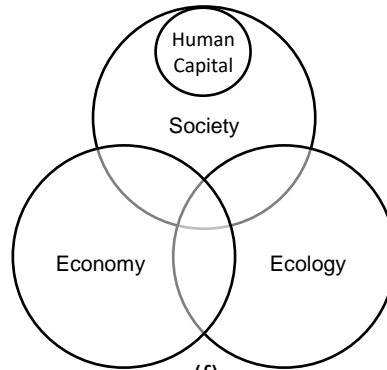
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(d)



(e)



(f)



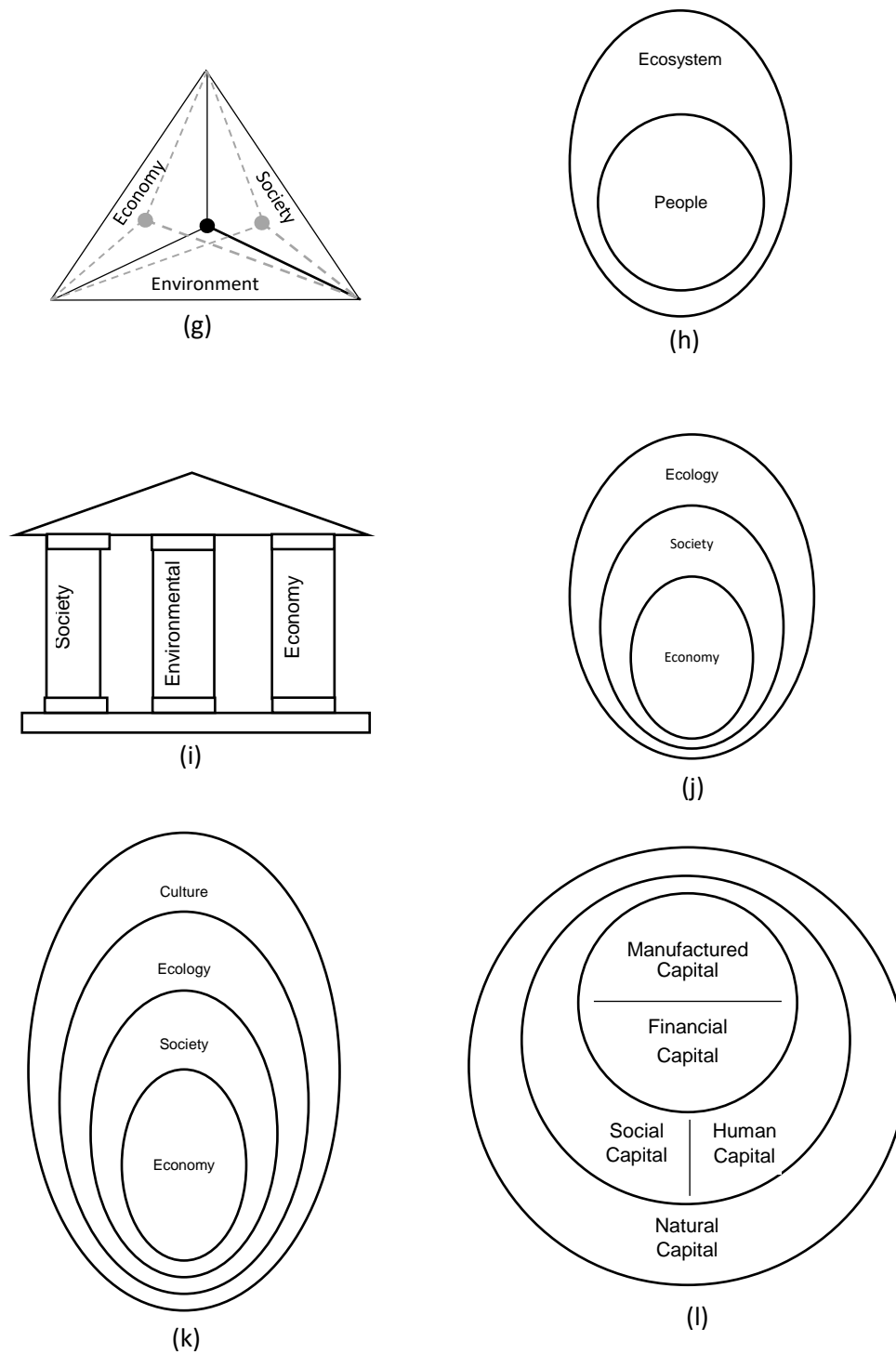


Figure 1 Graphic representations of sustainability

Sustainability performance is often strongly linked to its environmental dimension but the connection with other evolving and emerging areas of performance is transforming the traditional approaches to sustainable development. For instance, Kim and Go (2020) found that environmental performance is directly linked to political institutions and social capital, both of which are correlated to human capital. The development of human capital over time is also a function of the quantity and quality of human capital (which includes all forms of social capital), natural capital (e.g., ecosystem, air, water) and human-made capital (e.g., money, infrastructure, buildings, roads) and their evolution (Salus & Jacobs, 2011). To that extent, the individual's well-being is a determinant factor in the development and implementation of sustainable development strategies and achieving sustainability goals and objectives. With an individual-focused perspective, Becker (1962) made a distinction between specific and general human capital; the former includes training and qualities that benefit the individual at an organization whereas the latter can be associated with education and training that benefits a specific company. Similarly, Giarini (1980) identified four types of resources within the wide range of human capabilities of human capital: 1) social or organizational resources for governance, commerce, production, and education; 2) mental-intellectual resources such as ideas, knowledge, science, technology, and information; 3) cultural and psychological resources including values, customs, ways of life, character formation, personality development and individuality; and 4) productive resources such as skills and tool.

Although the scientific literature provides a plethora of definitions and factors, known henceforth as criteria or indicators, to include within the concept of human capital, other resources can provide further support in the early stages of the identification and selection processes of criteria and indicators.

#### **4. Resources for the identification and selection of human capital criteria and indicators**

Definitions of sustainability and human capital have merit in their attempt to encapsulate the essence of the concepts but both terms are embedded in vagueness. Barlett (2012) determined that the vagueness found in the definitions of sustainability allow it to mean whatever the user wants. Furthermore, Poveda (2016) indicates that the definition of the term has been subject to interpretation based on the specific interests of something or someone, which has generated confusion and increased the vagueness already embedded in the terminology. While the terminology is widely known, an agreed upon definition has not necessarily been accepted. As a result, the identification and selection of criteria and indicators become a determining factor for scientists and practitioners to properly capture the true meaning of the concept of sustainable development and its elements (e.g., human capital). Based on their origin, various resources for the identification and selection of human capital criteria and indicators can be clustered into the following four groups: commercially and research-based developed appraisal instruments; well-established, reliable, and reputable organizations, individuals or groups of academics and practitioners; and agreement reached through consensus. While the seven resources included in Figure 2 are the departing point for the identification and selection of human capital criteria and indicators, the use of scientific-based processes (e.g., multi-criteria decision-making [MCDM]) assist in refining the selection, validating the final set of

criteria and indicators, and evaluating their importance (i.e., weight) within the concept of sustainable development.

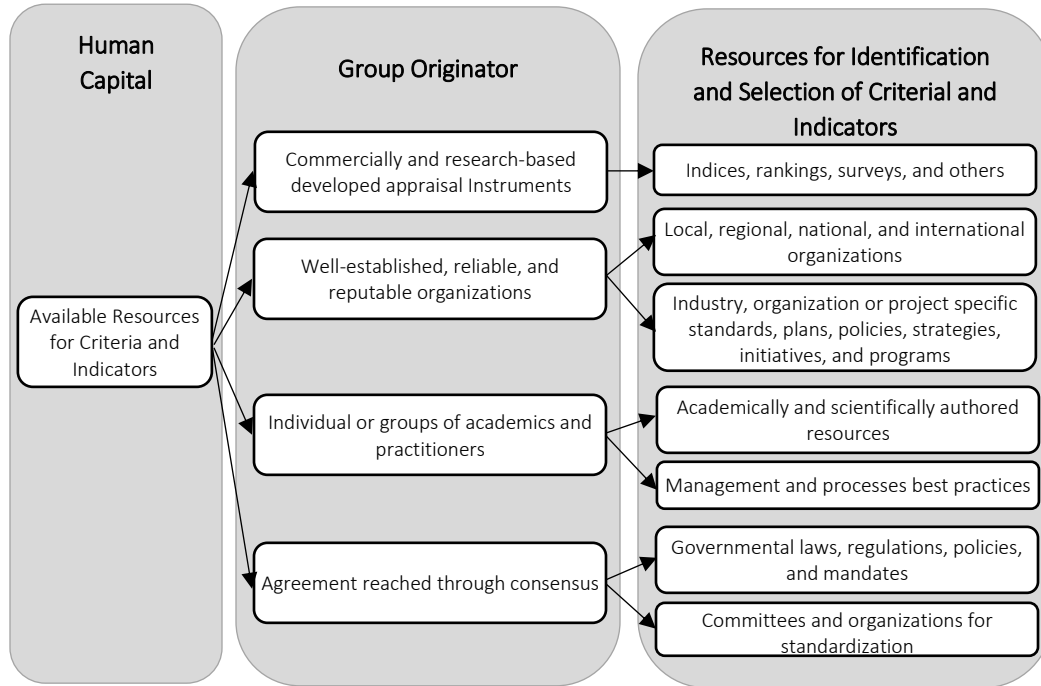


Figure 2 Resources for the identification and selection of human capital criteria and indicators

**a. Indices, ranking, surveys and others:** public and private organizations develop commercial or research-based appraisal instruments using the composite index approach. Instruments included in this group of resources typically group criteria under three sub-principles (i.e., dimensions, pillars) to then combine them to calculate the score or value of the principle (i.e., sustainability). Although it is rare for these instruments to include a criterion called human capital, their social dimension or pillar typically includes a set of indicators to address the human capital facet of sustainability. For instance, the quality of living, liveability or sustainability performance of cities and communities are commonly assessed, compared, and ranked using instruments such as the Sustainable City Index, Quality of Living Survey and Ranking, and Most Livable Cities Index developed by Arcadis, Mercer, and the Martin Prosperity Institute, respectively. A widely known and implemented set of appraisal instruments using the composite index approach are used in the construction environment. LEED, BREEAM, Green Globes, CASBEE, and Green Star are some of the rating systems used to assess environmental factors and sustainability of a wide range of projects within the construction industry. Other instruments have been designed to particularly measure human capital including the World Economic Forum Global Human Capital Index and the World Bank Human Capital Index.

**b. Local, regional, national, and international organizations:** public, private, non-governmental (NGOs), intergovernmental (IGOs), and many other types of organizations work towards achieving sustainability through the development, implementation, monitoring, and assessment of sustainability indicators frameworks. The United Nations (UN) is the most important IGO supporting sustainable development and climate action through its sustainable development agenda launched in 2015. The Sustainable Development Goals (SDGs) or Global Goals are part of the 2030 Agenda and they emphasize the interconnection and interdependent nature of the various aspects within the concept of sustainable development. On the other hand, sustainable development indicators (SDIs) “are to be developed at the appropriate level of detail to ensure proper assessment of the situation with regard to each particular challenge” (European Commission, 2009, p. 4). As a result, geographic-specific organizations focus on developing frameworks to meet local, regional, or national sustainability needs instead of using global frameworks.

**c. Industry, organization, or project-specific standards, plans, policies, strategies, initiatives, and programs:** the assessment of sustainability and human capital varies based on the type of industry, organization or project because the set of criteria and indicators are a direct reflection of the needs and vision of internal and external stakeholders. The potential of this category as a resource to help in the identification and selection of criteria and indicators can be illustrated in the following examples: 1) sustainability standards developed by the tourism industry for sustainable tour operations, sustainable destinations, sustainable hotels, and sustainable events and conferences among many others; 2) sustainability, green, and climate change plans developed by cities around the world, the Greenest City Action Plan (City of Vancouver, Canada) and OneNYC 2050: New York City’s Strategic Plan are two examples of these type of plans; 3) common practices include the development of environmental and sustainability policies, ESG (environmental, social, and governance) policies, and CSR (corporate social responsibility) policies; and 4) environmental and sustainability strategies, initiatives, and programs with elements of the facet of human capital embedded are designed and implemented by industries, organizations, and projects.

**d. Academically and scientifically authored resources:** the concept of sustainability has been around for centuries but gained traction in 1987 with the release of *Our Common Future*. With developments in every facet of sustainable development including human capital, academics and researchers with a wide range of backgrounds are motivated to study the implications of those developments and propose science-based solutions to achieve the vision of stakeholders in relation to sustainability goals and objectives. Academics and researchers are constantly proposing frameworks, instruments, methodologies, and many other appraisal approaches to assess and manage sustainability. Using theoretical or application-based approaches, academics and researchers provide credible and reliable resources for the identification and selection of sustainability and human capital criteria and indicators.

**e. Management and processes best practices:** industries, organizations, or projects aim to implement a set of practices that have proven an acceptable level of success over time. Best management practices (BMPs) are typically used to set a measurable desired level of operational or management performance. “Best practices in management and processes

may not have deep impacts on the functionality of the organization, as standards or management systems; though this enhances the flexibility characteristic of BMPs” (Poveda, 2014, p. 522). The best ways of doing something (i.e., performing a task) are captured in processes and procedures that serve as guidelines in the delivery of a product or service. While laws, regulations, policies, and mandates may direct the minimum set of requirements, BMPs are the ‘go-to’ set of guidelines for organizations, practitioners, stakeholders, and decision-makers to improve operational and management performance. BMPs can be found embedded in other types of resources (e.g., standards) or developed by governmental agencies, private organizations, industry associations, temporary partnerships, focus groups,

**f. Governmental laws, regulations, policies, and mandates:** either from self-motivation or as a result of public pressure, local, regional, national, and international governmental bodies have faced the reality of incorporating the need for achieving a more sustainable future into laws, regulations, policies, and mandates. As the concept of sustainability and sustainable development continues to evolve, the interconnection and dependent nature of its dimensions or pillars have put sustainability at the center of political agendas. While all dimensions or pillars must work in harmony, society and social development have become the engine to achieve inclusive and resilient societies where citizens have a voice and governments respond to their sustainability needs. Instead of being the finish line, governmental laws, regulations, policies, and mandates are the starting point in the identification and selection of criteria and indicators. To avoid becoming a bureaucratic tool, any set of criteria and indicators proposed by governmental agencies must be carefully analyzed and subsequently complemented with those identified and selected from the other six resources.

**g. Committees and organizations for standardization:** standards are repeatable, consistent, agreed upon, and documented processes that are developed by an authority which typically uses general consent as a basis of comparison. Standards set a rule for following or measuring a specific process with a level of expected quality that is generally accepted as normal. Different committees and organizations around the world are dedicated to identifying and developing the standards to better make products, manage a process, deliver a service, or supply products and materials. Because of the need to incorporate sustainability into their standards, committees and organizations for standardization have reviewed and updated standards already published or developed brand new standards to address specific market or industry needs. While the International Organization for Standardization (ISO) and its 167 national standards bodies are the most widely known organization enacting standards, many other committees and organizations for standardization can serve as resources for identifying and selecting criteria and indicators for sustainability and human capital.

## **5. Evaluating the importance of human capital within the concept of sustainable development**

The Venn diagram illustrated in Figure 1(d) is the most widely known graphic representation of sustainability. The intersecting circles imply an equal weight (i.e., relevance or importance) for each of the dimensions or pillars. Although the equal weight is a mere assumption and matter of interpretation, the relevance or importance of the

various facets included in other graphic representations and frameworks has a determinant factor in the outcomes of the sustainability assessment process. Because capturing the various facets of sustainable development is the main objective in sustainability assessment studies, holistic approaches, strategies, methodologies, models, and appraisals usually include a number of areas of performance within each dimension or pillar. These areas of performance are grouped into the three most common pillars or dimensions: social, economic, and environmental. Human capital is an area of performance within the social pillar and its relevance can be determined using the composite index approach with the assistance of MCDM or multi-criteria decision analysis (MCDA) methods.

### **5.1 Hierarchical Structural Organization (HSO) in sustainability assessment**

Sustainability assessment studies use a wide range of tools which can be integrated into the following three groups: indicators and indices, product-related assessments, and integrated assessments (Ness et al., 2007). The use of indicators has gained popularity because of their simplicity in representing the state of a specific area of performance. Indicators can be integrated or non-integrated depending on the need to integrate the different areas of performance. An index, formally known as a composite index, results from the integration of various indicators representing the respective areas of performance.

To organize the elements within a composite index and facilitate the assessment and interpretation of results, sustainability assessment studies often use the HSO approach. The elements within composite indices follow the structure illustrated in Figure 3. The highest level of the HSO is the principle. The principle represents a statement of the fundamental desired outcome. The principle of sustainability is often formulated around the core concept of sustainable development. Sustainability as a principle is shaped by stakeholders' vision, values, traditions, needs, and scientific knowledge among other factors. The principle can include a number of sub-principles (composite sub-indices from the sustainability assessment standpoint). The second level of the HSO often includes sub-principles aligned with the three dimensions or pillars of sustainability. Social, economic, and environmental performances can be measured and presented as composite sub-indices.

Criteria can be found in the third level of the HSO. "Criteria are the intermediate points to which the information provided by indicators can be integrated and where an interpretable assessment crystallizes" (Pokorny & Adams, 2003, p. 20). Therefore, criteria add meaning and functionality to the sub-principle without themselves becoming a direct measure of performance. Energy, water, air quality, climate, and education are some examples of criteria often included in a sustainability assessment. To evaluate the performance of each criterion, indicators are designed to capture and deliver the corresponding information. Therefore, indicators determine whether or not a particular criterion has the desired performance. Verifiers are the lowest level of the HSO. Verifiers collect data, information, or observations used to demonstrate the desired state of performance or reflect the current condition of an indicator.

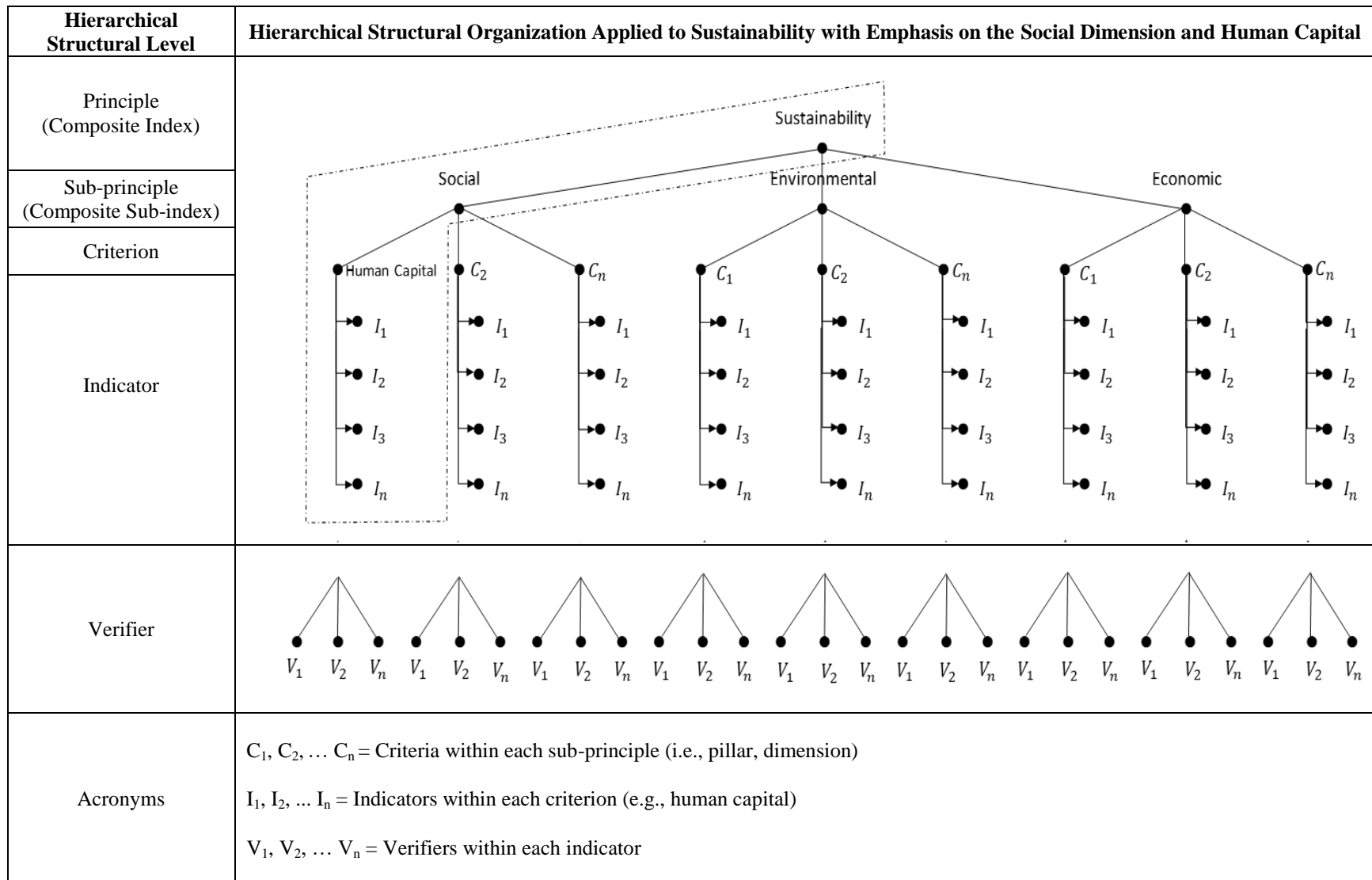


Figure 3 Hierarchical structural organization (HSO) commonly used in sustainability assessment studies

## **5.2 Using MCDM and MCDA to weight the elements within the HSO**

With an absolute weight of 100%, the principle (i.e., sustainability) is the only element within the HSO with a fixed weight. Although other elements can be equally weighted to facilitate or expedite the assessment process, assigning equal weights to sub-principles, criteria, and indicators most likely does not reflect the accurate importance of the element(s) within the concept of sustainable development.

As the sum of the weights of the elements in each level of the HSO must add to 100%, the importance or relevance of an element is determined by its weight in relation to the others within the same level of the HSO. MCDM and MCDA can assist in the selecting, ranking and weighting indicators, criteria, and sub-principles. The main focus of MCDM and MCDA is structuring and solving decision and planning problems with multiple criteria. MCDM and MCDA have rapidly evolved and been applied to solve problems in a wide range of areas including but not limited to finance, education, transportation, ecology, supply chain, urban sanitation, and economy. MCDM and MCDA problems can be grouped into the following three categories: multi-criteria choice, multi-criteria ranking, and multi-criteria sorting (Vassilev et al., 2005). Independent of the type of problem, the decision maker (DM) is an influential factor in the success of the decision-making process. The DM gives additional information to select the preferred alternative(s) and also provides input based on his/her preferences according to the goals (Poveda & Lipsett, 2013). The several methods developed to solve multi-criteria problems can be grouped into the following three classes: multi-attribute utility theory (MAUT) methods, outranking methods, and non-classical MCDA approaches.

First, the MAUT methods provide the DM with the opportunity to quantify the appeal (i.e., desire to select) of a number of alternatives in which the DM handles a level of uncertainty, risk, and trade-offs among the multiple alternatives. Second, the outranking methods depart from the assumption that there is limited comparability among the alternatives. It is assumed in most outranking methods that the DM “is unable to differentiate among the four binary relations (i.e., the indifference I [reflexive and symmetric], the weak preference Q [irreflexive and antisymmetric], the strict preference P [irreflexive and antisymmetric], and the incomparability R [irreflexive and symmetric]) used to compare two alternatives” (Poveda & Lipsett, 2013, p. 207). Third, the non-classical MCDA approaches require making a distinction between internal and external uncertainties. While external uncertainties are associated with imperfect knowledge related to the consequences of actions, internal uncertainties refer to the DM’s values and judgements (Figueira et al., 2005). Table 1 includes some of the most popular MCDM and MCDA methods used to select, rank, and weight alternatives through decision makers’ (i.e., stakeholders’) participation.



Table 1  
MCDM and MCDA methods

<b>Multi-attribute Utility Theory (MAUT) Methods</b>	<b>Outranking Methods</b>	<b>Non-classical MCDA Approaches</b>
Analytic Hierarchy Process (AHP)	Preference Ranking Organization Method for Enrichment of Evaluations (PROMETHEE) Methods	Fuzzy-PROMETHEE
Analytic Network Process (ANP)	Includes: PROMETHEE I, PROMETHEE II, PROMETHEE III, PROMETHEE IV, PROMETHEE V, and PROMETHEE VI.	PROMETHEE-GAIA  PROMETHEE-GDSS
UTilites Additives (UTA) Methods	Élimination Et Choix Traduisant la Réalité (ELECTRE) Methods	
Value Tradeoff Method	Includes: ELECTRE I, ELECTRE-IV, ELECTRE-IS, ELECTRE II, ELECTRE III, ELECTRE IV, ELECTRE TRI, and ELECTRE-A	
Direct Weighting Method	TACTIC Method	
Measuring Attractiveness by a Categorical Based Evaluation Technique (MACBETH) Method		

Note: The table is not comprehensive; it only includes some of the most popular MCDM and MCDA methods.

## 6. Simulated case study: Importance of human capital in the sustainability of financial institutions

Organizations from a wide range of industries release an annual ESG, corporate social responsibility (CSR) or sustainability report. Financial institutions include a set of indicators under a number of criteria to evaluate performance in areas such as social, economic, governance, and environment among others in their reports. While financial institutions are not mandated to follow a standardized template to report ESG, CSR or sustainability performance, some commonalities in sub-principles (i.e., dimensions or pillars), criteria, and indicators can be found. Financial institutions may use other key performance indicators (KPIs) to measure, track and manage performance in various areas; however, annual reports released to the public include those with a critical role in achieving the organization's sustainability goals, objectives, and vision and are considered important to stakeholders, shareholders, and stockholders.

The Canadian 'Big Six' financial institutions include the Royal Bank of Canada (RBC), Toronto-Dominion Bank (TD Canada Trust), Bank of Nova Scotia (Scotiabank), National Bank of Canada, Bank of Montreal (BMO), and Canadian Imperial Bank of Commerce (CIBC). The latter two release an annual sustainability report whereas the other four financial institutions share their performance information in an ESG report. Scotiabank, a leading financial institution in the Americas, has a team of over 90,000 employees and assets of over \$1.3 trillion (as of January 31, 2023) (Scotiabank, 2023a). Scotiabank received Excellence awards in Human Capital Management from Brandon Hall Group for Best Unique/Innovative Leadership Development Programs for its Data and Analytics Skill Building and iLEAD People Manager Essentials programs (Scotiabank, 2021). Scotiabank was also named one of Canada's Most Admired Corporate Cultures for 2021 by Waterstone Human Capital (Scotiabank 2021). Scotiabank's performance in human capital can be linked directly to the multiple awards over the years in Canada and

throughout the Americas as Top Employer, Best Workplace, Corporate Governance, or specific areas of performance such as diversity, gender equality, inclusion, leadership, and social responsibility among many others (Scotiabank, 2023b). Furthermore, some of the latest recognitions received by Scotiabank include six wins in the 2022 Global Finance Sustainable Finance Awards including Best Bank in Canada for leadership in sustainable finance (Scotiabank, 2023c), North America's Best Bank for Sustainable Finance at the 2022 Euromoney Awards for Excellence (Scotiabank, 2023d), and the 2022 Corporate Equality Index: Best Places to Work for LGBTQ+ Quality with a perfect score of 100% (Scotiabank, 2023e). Scotiabank's size (i.e., number of employees), solid status in the financial market, and ESG performance indicate a successful approach by the institution to attract, develop and preserve its human capital. Therefore, Scotiabank's ESG report and performance provide the right conditions to apply MCDM or MCDA methods, in particular the AHP, to evaluate the importance or relevance of human capital in achieving the overall sustainability vision, goals, and objectives.

### **6.1 Analytical Hierarchy Process (AHP): Brief theoretical background and assigning weights**

Developed in the 1970s by Thomas L. Saaty, the AHP, one of the most widely used and easily implemented MAUT methods, structures the decision problem in a hierarchy and applies a measurement scale to obtain vectors of normalized weights or priorities using pairwise comparisons (Saaty, 1977). Furthermore, Bouyssou et al. (2006) describe three characteristics for building an evaluation model using the AHP method: 1) the evaluation model is structured in a hierarchical way; 2) the same assessment technique is used at each node of the hierarchy; and 3) the assessment of the "children" nodes of a common "parent" node is based on pairwise comparisons. The node at the top of the hierarchy represents the main objective of the decision problem to be resolved by the decision maker. Based on the number of alternatives, nodes at each level of the hierarchy can split as many times as there are alternatives. The end result for each node is the aggregation of the analysis of the alternatives in the level node immediately below. Saaty (2008) structures the decision problem in the following four steps: define the problem and knowledge sought; structure the decision hierarchy; build the pairwise comparison matrices; and weight the priorities. To assign weights or scores to each 'child' node (i.e., alternative) of a 'parent' node, the decision maker follows a three steps process: 1) the decision maker is asked to compare the alternatives (e.g., sub-principles, criteria, indicators) in a pairwise comparison in terms of their relative importance using a conventional semantic scale; 2) the qualitative assessments given by the participants are quantified (i.e., quantitative interpretation), resulting in an  $n \times n$  pairwise comparison matrix; and 3) the pairwise comparison matrix is used to determine a score or weight  $w_i$ ; then the eigenvector corresponding to the maximum eigenvalue of the matrix is computed, and normalized to add up to 1.

Although slight modifications related to its interpretation and conceptual additions have been made, the measurement scale used by the AHP method has not been fundamentally changed over the years. Table 2 illustrates the adaptation of Poveda and Lipsett (2013) to the measurement scale used by decision-makers in the AHP method. The measurement scale assists in the construction of pairwise matrices. The values within the pairwise matrices show the degree of importance or relevance that an element (e.g., sub-principles, criteria, indicators) within the same hierarchical level has over the others when they are compared pairwise.

Table 2  
Measurement scale used in the AHP method

<b>Intensity of Importance</b>	<b>Definition</b>	<b>Explanation</b>
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight importance	
3	Moderate importance of one over another	Experience and judgment slightly favor one activity over another
4	Moderate plus importance	
5	Essential or strong importance	Experience and judgment strongly favor one activity over another
6	Strong plus importance	
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance is demonstrated in practice
8	Very, very strong importance	
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
Where; 2, 4, 6, 8	Intermediate values between the two adjacent judgments	When compromise is needed
1.1–1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities
Reciprocals	If activity <i>i</i> has one of the above non-zero numbers assigned to it when compared with activity <i>j</i> , then <i>j</i> has the reciprocal value when compared with <i>i</i>	A reasonable assumption
Rationals	Ratios arising from the scale	If consistency were to be forced by obtaining <i>n</i> numerical values to span the matrix

In the AHP method, the relevance or importance of a series of elements (e.g., sub-principles, criteria, or indicators) is determined using pairwise comparison matrices. An element compared with itself has a weight valued as 1. The structure of pairwise comparison matrices consists of a number of elements, *M*, and a series of criteria, *N*. Criteria *N* are the same elements *M*. The formation of a pairwise comparison matrix results in a certain element *M* becoming an *N* criterion (e.g.,  $M_1 = N_1$ ). Because elements can be assessed in terms of every criterion, the relevance or importance (i.e., weight) of each element can be calculated as well. Furthermore,  $a_{ij}$  represents the weight of an element over a criterion where,  $i=1,2, 3, \dots, M$  and  $j=1,2,3, \dots, N$ . The pairwise comparison matrix below represents the basic decision problem to be solved using the AHP method to weight the alternatives in each hierarchical level:

Criteria	Alternative						Alternative/Criteria
	$M_1$	$M_2$	$M_3$	$M_4$	.....	$M_M$	Absolute Weights
$N_1$	$a_{11}$	$a_{12}$	$a_{13}$	$a_{14}$	.....	$a_{1M}$	$w_1$
$N_2$	$a_{21}$	$a_{22}$	$a_{23}$	$a_{24}$	.....	$a_{2M}$	$w_2$
$N_3$	$a_{31}$	$a_{32}$	$a_{33}$	$a_{34}$	.....	$a_{3M}$	$w_3$
$N_4$	$a_{41}$	$a_{42}$	$a_{43}$	$a_{44}$	.....	$a_{4M}$	$w_4$
.	.	.	.	.		.	.
.	.	.	.	.		.	.
.	.	.	.	.		.	.
$N_N$	$a_{N1}$	$a_{N2}$	$a_{N3}$	$a_{N4}$		$a_{NM}$	$w_{NM}$

Where;

$M_1 = N_1,$	$a_{11} = w_{N1}/w_{M1}$	$w_1 = w_{N1} = w_{M1}$
$M_2 = N_2,$	$a_{21} = w_{N2}/w_{M1}$	$w_2 = w_{N2} = w_{M2}$
$M_3 = N_3,$	$a_{31} = w_{N3}/w_{M1}$	$w_3 = w_{N3} = w_{M3}$
$M_4 = N_4,$	$a_{41} = w_{N4}/w_{M1}$	$w_4 = w_{N4} = w_{M4}$
.	.	.
.	.	.
.	.	.
$M_M = N_N$	$a_{21} = w_{N2}/w_{M1}, etc$	$w_{NM} = w_{NN} = w_{MM}$

## 6.2 Weighting the importance of human capital within the context of sustainable development

The latest ESG report released by Scotiabank includes the following four sub-principles (i.e., pillars or dimensions): governance, sustainable finance, environment, and social. Table 4 organizes the criteria and indicators under each sub-principle. Additionally, sub-principles, criteria, and indicators have been codified to facilitate the description of the elements within the text and their graphic representation. A total of 32 indicators were found in the ESG report with the social sub-principle being the only one using four criteria to group the selected set of indicators. Two out of the four criteria in the social sub-principle group include the indicators linked to human capital. Criteria C-1 and C-2 include four and seven indicators, respectively.

Establishing the hierarchy is the first critical step to assessing the importance (i.e., weight) of the different elements included in Scotiabank’s ESG report using the AHP method. Figure 4 illustrates the various levels in the hierarchical structure and how they are linked. For this simulated case, the weights of each sub-principle, criteria under the social sub-principles and indicators under criteria C-1 and C-2 are needed to assess the importance of human capital within the context of sustainable development. The four clusters of indicators (i.e., criteria) under the social sub-principle do not include an equal number of indicators. Indicators reflect a specific facet of ESG or sustainable development or can be a combination of two more facets; these indicators are often called

multi-facet or multi-attribute indicators. Each element, but in particular indicators, is designed to capture, track, and manage the organization's performance in order to achieve the desired sustainability vision, goals, and objectives.

Establishing and understanding the hierarchical structure is the preliminary step to forming the pairwise comparisons using the measurement scale described in Section 5.1 and illustrated in Table 2. The pairwise comparison process consists of a free evaluation of the relative importance of each sub-principle over others by the decision-maker(s). The first pairwise comparison computes the relative priorities of the sub-principles in a 4 x 4 matrix which includes the following elements: governance (SP-1), sustainable finance (SP-2), environment (SP-3), and social (SP-4). The second set of pairwise comparison matrices includes the elements within each sub-principle. Because SP-1, SP-2, and SP-3 do not use criteria to group the set of indicators included in each one of them, the only pairwise comparison is a 4 x 4 matrix formed by criteria C-1, C-2, C-3, and C-4. The fourth level of the hierarchical structure includes a larger number of matrices. These pairwise comparisons evaluate the relative importance of each indicator over others included in each specific criterion. Furthermore, sub-principle SP-4 (i.e., social) includes four criteria which result in individual pairwise comparison matrices. The two criteria including indicators linked to human capital are C-1 and C-2 which form 4 x 4 and 7 x 7 pairwise comparison matrices, respectively.

Table 4  
Sub-principles, criteria, indicators included in Scotiabank’s ESG report

Sub-Principles		Criteria		Indicators	
Name	Code	Name	Code	Name	Code
<b>Governance</b>	SP-1	Indicators are not grouped using criteria	N/A	Board of directors	I-1
				Employees that attested to the Scotiabank code of conduct	I-2
				Dow Jones Sustainability Index (DJSI) North America	I-3
				CDP climate change score	I-4
<b>Sustainable Finance</b>	SP-2	Indicators are not grouped using criteria	N/A	Green, social, sustainable and sustainability-linked bonds underwritten	I-5
				Green, sustainable and sustainability-linked loans	I-6
				Sustainability and green bonds purchased by Scotiabank	I-7
				Sustainability and green bonds issued by Scotiabank	I-8
<b>Environment</b>	SP-3	Indicators are not grouped using criteria	N/A	Capital mobilized for climate-related finance	I-9
				% of electricity from non-emitting sources	I-10
				% decrease in Scope 1 and 2 greenhouse gas (GHG) emission from 2016 levels	I-11
				Internal Carbon Price per tonne CO <sub>2</sub> e	I-12
				Total GHG emissions (global, tonnes CO <sub>2</sub> e)	I-13
				Employee engagement score	I-14
				Employees who believe Scotiabank is committed to being socially responsible	I-15
				Voluntary employee turnover rate	I-16
				Total investment in employee training and career development	I-17
				Executive Management Team - % women	I-18
Women	I-19				
<b>Social</b>	SP-4	Investing in Our Employees	C-1	People of color	I-20
				Persons with disabilities	I-21
				Indigenous peoples	I-22
				Diverse gender identity	I-23
				Employees that identify their sexual orientation as being lesbian, gay, bisexual or another diverse sexual orientation	I-24
		Empowering Our Customers	C-3	Customer experience – Number of follow-up calls made to retail customers	I-25
				Customer case reviews completed by the office of the ombudsman	I-26
				Small business loans	I-27
		Building Resilience in Our Communities	C-4	Access to banking for Indigenous communities, businesses and peoples	I-28
				Access to banking. Total Scotiabank Colpatria zero-fee accounts	I-29
Economic value distributed	I-30				
Total value of community investment	I-31				
Total number of hours volunteered by employees	I-32				

Note: Scotiabank doesn’t assign codes to sub-principles (e.g., governance) and criteria (e.g., investing in our employees). Codes are use to facilitate the description of the elements within the text and their graphic representation in Figure 4.

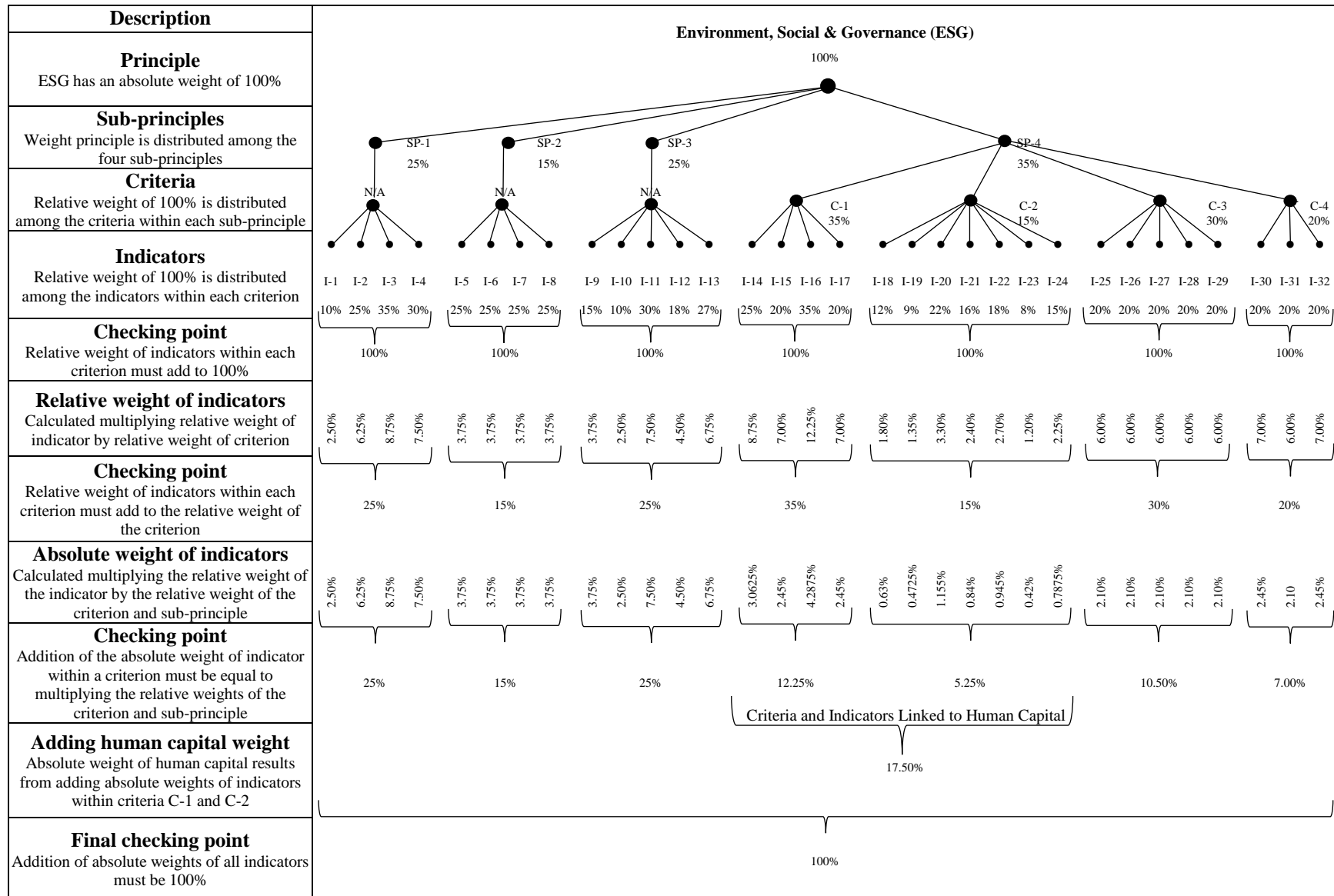


Figure 4 Weight distribution for sub-principles, criteria, and indicators included in the Scotiabank’s ESG report

The outcomes of the pairwise comparison matrices allow the calculation of relative and absolute weights of each element within the hierarchical structure. Relative weights can be calculated to indicate the importance or relevance of an element in relation to others within a set or group (e.g., criteria) at the same level of the HSO. Relative weights can also be calculated to understand the importance or relevance of an element in relation to the hierarchical levels above of it. The weight of an element in the fourth hierarchical level that considers the relative weights of the nodes in each hierarchical level above becomes the absolute weight of the element; absolute weight refers to the importance or relevance of an element in the whole hierarchical structure.

The AHP method results in allocating relative and absolute weights to the four criteria (C-1, C-2, C-3, C-4) included in the social sub-principle. To illustrate the difference between relative and absolute weights, consider criterion C-1 (investing in our employees). The relative weights for criterion C-1 resulted in 35%; the remaining 65% is distributed among the other three criteria included in SP-4 (social sub-principle). The absolute weight of a criterion can be calculated as follow:

$$Weight_{absolute} = (Weight_{relative} \text{ Criterion}) \times (Weight_{relative} \text{ Sub - principle})$$

Calculation for criterion C-1,

$$Weight_{absolute} = (0.35 \times 0.35) = 0.1225 \text{ or } 12.25\%$$

Similarly, the relative and absolute weight of an indicator can be calculated. The relative weight of indicator I-14 resulted in 25%; the remaining 75% is distributed among the other three indicators included in criterion C-1. The absolute weight of an indicator can be calculated as follow:

$$Weight_{absolute} = (Weight_{relative} \text{ Indicator}) \times (Weight_{relative} \text{ Criterion}) \times (Weight_{relative} \text{ Sub - principle})$$

Calculation for indicator I-14,

$$Weight_{absolute} = (0.25) \times (0.35) \times (0.35) = 0.030625 \text{ or } 3.0625\%$$

Because criteria C-1 and C-2 include the indicators linked to human capital, the AHP method allowed the identification of a relative weight of human capital of 50% within the social sub-principle. Similarly, the absolute weight of human capital was 17.5% which represents the importance or relevance of human capital in meeting the ESG goals, objectives and vision of the organization.

### **6.3 Sensitivity analysis: Evaluating the impact of human capital on the overall ESG performance**

The sensitivity analysis to determine how the different weight values of the independent variables (i.e., indicators linked to human capital) affect the weight of other dependent variables (e.g., indicators, criteria, sub-principles) must consider the HSO and the elements (i.e., sub-principles, criteria, indicators) within each of its levels. Furthermore, while the absolute weight of the principle remains at 100%, the weights of the other



elements in the HSO depend on the approach used. Four approaches can be used to determine the weights of the elements in the HSO: 1) equal weight approach; 2) top-down approach; 3) mixed approach; and 4) bottom-up approach.

The equal weight approach considers the equal distribution of weight among the elements within the same level of HSO; therefore, MCDM or MDMA methods such as the AHP methodology are not needed to assign the weights based on the relevance of an element in relation to the others.

The top-down approach allocates equal weights to the elements within the sub-principle level (i.e., SP-1, SP-2, SP-3, and SP-4 have the same weight), but the weights of the elements within the criterion and indicator levels are the result of applying the AHP methodology. Therefore, the top-down approach presents several potential outcomes to the impact of human capital indicators. Table 5 presents each scenario of the potential impact of human capital on the overall ESG performance. The weights of indicators linked to human capital can vary, increase or decrease. Because the weights of the sub-principles are already set after their weights have been equally distributed, the impact of the weights of indicators linked to human capital can only have an effect on the weights of the criteria C-1 (investing in our employees) and C-2 (leadership and employee diversity). The weights of the criteria can increase even if the weights of the indicators linked to human capital decrease because the human capital indicators are mixed with other types of indicators under the same criterion. Similarly, the weights of the criteria can decrease even if the weights of the indicators linked to human capital increase.

**Table 5**  
Potential impact of human capital indicators to the overall ESG performance

Approach to weighting elements within each level of the HSO	Principle ESG	Sub-principle (Social [SP-4])	Criterion C-1 (Investing in Our Employees)	Criterion C-2 (Leadership and Employee Diversity)	Indicators linked to human capital
<b>Equal Approach</b>	100%	↔	↔	↔	↔
<b>Top-down Approach</b>	100%	↔	↔	↔	↑
	100%	↔	↑	↑	↑
	100%	↔	↑	↓	↑
	100%	↔	↓	↑	↑
	100%	↔	↓	↓	↑
	100%	↔	↑	↓	↓
	100%	↔	↓	↑	↓
	100%	↔	↓	↓	↓
	100%	↔	↑	↑	↓
	100%	↔	↓	↓	↓
<b>Mixed Approach</b>	100%	↔	↑	↓	↔
	100%	↔	↓	↑	↔
	100%	↔	↓	↓	↔
<b>Bottom-up Approach</b>	100%	↑	↑	↑	↑
	100%	↑	↑	↓	↑
	100%	↑	↓	↑	↑
	100%	↑	↓	↓	↑
	100%	↑	↑	↓	↓
	100%	↑	↑	↓	↓
	100%	↑	↓	↑	↓
	100%	↑	↓	↓	↓
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	100%	↓	↑	↓	↑
	100%	↓	↓	↑	↑
	100%	↓	↓	↓	↑
	100%	↓	↑	↓	↓
100%	↓	↓	↑	↓	
100%	↓	↑	↓	↓	
100%	↓	↓	↓	↓	
100%	↓	↑	↑	↓	

**Symbols:**  
↔ = The weights of the elements within the same level of the HSO are equally distributed  
↑↓ = The weights of the elements within the same level of the HSO are variable  
↑ = The weight of the elements within the same level of the HSO increases  
↓ = The weight of the elements within the same level of the HSO decreases

The mixed approach allocates equal weights to the elements within the sub-principle and indicator levels; therefore, the AHP methodology is not implemented in the weight allocation process. The AHP methodology is an instrument to allocate the weights of the elements within the criterion level. The weights of criteria C-1 (investing in our employees) and C-2 (leadership and employee diversity) vary. Since criteria C-1 and C-2 mix human capital with indicators that measure other facets of the social sub-principles (SP-4) and the indicators are equally weighted, indicators linked to human capital have limited impact on the weight of criteria C-1 and C-2. Nevertheless, few potential outcomes can be identified after applying the AHP methodology. Table 5 includes three scenarios: 1) the weights of both C-1 and C-2 increase or decrease simultaneously; 2) the weight of C-1 increases and the weight of C-2 decreases; and 3) the weight of C-1 decreases and the weight of C-2 increases.

The bottom-up approach uses the MCDM or MCDA methods such as the AHP methodology to allocate weights to the elements within the indicator level. Then, the

values of the weight of the criteria are the result of adding the weights of the indicators within each specific criterion. Similarly, the values of the weights of the sub-principles are the result of adding the weights of the criteria within each specific sub-principle. Adding the weights of the sub-principles results in the absolute weight of the principle. The principle is at the top of the HSO and its absolute weight is set at 100%. Using the bottom-up approach, the impact of indicators linked to human capital on the weights of criteria C-1 (investing in our employees) and C-2 (leadership and employee diversity) and sub-principles SP-4 (social) increases. Table 5 includes the different potential scenarios of the impact of the indicators linked to human capital. Stakeholder and decision-maker groups could use the bottom-up approach to allocate higher weights to indicators linked to human capital and influence the ESG performance of the organization (i.e., Scotiabank).

## **7. Conclusions**

Sustainability and human capital are continuously evolving concepts. A concept with a modest origin linked to productivity and economic growth has become one of the engines to achieve the vision, goals, and objectives of sustainability. Human capital has a supporting and coordinating role among the various pillars or dimensions included in the concept of sustainable development. Furthermore, the development of human capital has a determinant and direct impact on reducing environmental degradation and improving environmental protection while advancing social progress and economic growth.

Although the impact of human capital has become noticeable, the degree of its importance or relevance in meeting the goals and objectives of sustainable development and achieving the stakeholders' vision of sustainably and ESG is still uncertain. Evaluating the impact of human capital has a number of challenges. First, the constant evolution of the concepts makes a widely accepted and useful definition in sustainability assessment studies evasive. Second, human capital is not and cannot be a static concept. The characteristics of human capital vary based on the specific needs of a project, organization, or industry. Therefore, the concept of human capital has temporal and spatial features which indicate its adaptable nature in time and context. Third, the two previous challenges contribute to the already difficult task of assessing human capital. Either identifying and selecting the proper set of criteria and indicators or evaluating the relevance or importance of human capital within the sustainable development context, practitioners and scientists face the need to better understand the concept itself and its role in broader contexts.

The assessment of human capital can be assisted by MCDM and MCDA methods. Structured and scientific-based methodologies using an effective engagement and participation of stakeholders presents a valid and reliable option for understanding the importance or relevance of human capital in meeting the goals and objectives of sustainable development. Among a wider range of options, the AHP method captures pre-established goals and objectives through the development of pairwise comparison matrices that include elements identified and selected by stakeholders. Furthermore, the assessment process allows stakeholders to embed their vision of a sustainable future and the priority that should be given to the various facets of the concept of sustainable development and each element within it.

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