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Creating and claiming social value by joining the governance of science-driven capital projects: an investigation in the New Space Economy

Alessandro Paravano[1*], Giorgio Locatelli[1], Paolo Trucco[1]

[1]Politecnico di Milano, School of Management, Via Lambruschini 4, 20156, Milano, Italy,

*Corresponding author. alessandro.paravano@polimi.it

Keywords

Environmental, Social and Governance (ESG); Low Earth Orbit; Innovation; Complex Project Business; Emerging Technologies; Digital technologies; Triple Bottom Line; SDGs; Project Strategy; Corporate Social Responsibility (CSR)

Abstract

In a world facing grand challenges, companies urge to create and claim social value. This paper explains how organisations can achieve this by joining the governance of science-driven capital projects. The research addresses two significant gaps: the limited academic understanding of how science-driven capital projects create social value and the empirical lack of guidelines for companies to harness these projects. The empirical setting is the space sector, specifically the International Space Station (ISS) project. We adopted a two-stage research design. First, based on public documents and reports, we investigated the governance and social value of projects developed on the ISS, finding that social value is created through "In-Space" and "On-Earth" projects. Second, we performed a thematic analysis of 18 semi-structured interviews with senior managers, obtaining a roadmap to create and claim social value by joining the governance of the ISS. The paper contributes to the theory by explaining how science-driven capital projects create social value and their key governance elements. We show that space is becoming accessible to many non-space companies. We contribute to practice by clarifying the main governance elements of science-driven capital projects and providing a roadmap to create and claim social value by joining their governance.

1. Introduction

A company CEO and an Environmental Social and Governance (ESG) manager are discussing the next edition of their company's ESG report. They are concerned about what to include regarding social value, then the ESG manager takes a glass of water from a dispenser and has an epiphany.

ESG: "I know it! My brother works at Procter & Gamble. Last year, they worked with NASA to develop a biodegradable soap to clean astronaut suits [1]. It reduced the energy and water consumption of the International Space Station (ISS). The know-how from that research project is now used to develop a new commercial soap perfect for people living in regions with energy and water scarcity. This year, they claim the social value created in their ESG report [2]!".

CEO: "Interesting. Now that you've got me thinking… My wife is a manager at Target Corporation, and recently, they sponsored with NASA, or one of their offices, the "ISS cotton sustainability challenge [3]", providing grants to test their ideas for improving crop production and water sustainability on Earth with ISS. They claim the social value in their ESG report [4]".

ESG: "Joining the governance of capital projects in the space sector could be a good idea to create social value! The space sector is dramatically evolving, becoming more accessible for companies of other sectors like ours".

CEO: "Can we really create and claim social value by developing projects on the ISS like P&G and Target? How?".

Our paper delves into the issue outlined in the preceding vignette. Particularly, we aim to explain how organisations can create and then claim social value by joining the governance of science-driven capital projects. Because of its novelty and industrial relevance, we focus on the space sector. Let's clarify the key elements of our research.

In a world facing grand challenges such as climate change, population ageing, and inequalities, companies are increasingly required to create social value [5], [6]. Companies create social value

when their activities generate social benefits (e.g., well-being, equity, and sustainable societal welfare) [7] for their stakeholders, such as customers, suppliers, and employees [8] and society [9]. By creating social value, companies not only meet stakeholders' and society's ethical expectations but also gain economic returns and competitive advantage [10]. For example, over the last five years, products with Environmental Social and Governance (ESG) related claims saw significant growth and achieved an average cumulative growth of 28% compared to 20% for those without such claims [11]. Moreover, 95% of employees believe businesses should benefit all stakeholders - not just shareholders, and 41% of millennial investors put a significant amount of effort into understanding a company's Corporate Social Responsibility (CSR) practices, compared to just 27% of Gen X and 16% of baby boomers [12].

To this end, companies are increasingly compelled to claim social value by developing and adopting more comprehensive and transparent reporting frameworks [7] to incorporate social impact metrics into financial ones, such as corporate CSR reporting, ESG reporting, third-party standards, and certifications to support organisations in their social responsibility efforts [13]. In 2022, 96% of the world's 250 largest companies by revenue based on the 2021 Fortune 500 ranking published a CSR report, compared to 45% in 2002 [14].

Companies can leverage several initiatives to create social value and claim it (e.g., financial support for local community development, investing in public health initiatives, and supporting NGOs). Among these initiatives, companies are increasingly developing capital projects as a means of social value creation [15]. Just to give you an idea, McKinsey estimates that between 2022 and 2027, roughly $130 trillion will be invested into capital projects to decarbonise and renew critical infrastructure [16]. In this article, we subscribe to Gil et al. conceptualisation of capital projects as a *"form of organising that is enabled by society to produce capital-intensive technology – broadly defined to include infrastructure, manufacturing facilities, defence systems, and technology to make science and discoveries"* [5, p. 1].

The literature distinguishes between two main capital project groups [17], [18]. The first group is infrastructure and defence-driven capital projects, which provide infrastructure and services as the main aim, e.g. building railways, producing electricity, and developing energy distribution infrastructure. Capital projects in this group are based on established technologies and do not need major scientific breakthroughs [19]. The social value created by infrastructure and defence capital projects has been largely investigated, considering both value enacting mechanisms and impact [5], and managers can leverage several practices to develop these capital projects to create social value. The second group is science-driven capital projects, aiming to progress knowledge and technology readiness [15], [20]. There are several kinds of science-driven capital projects; the most recent ones include ITER (a $25 billion experimental fusion plant developed by 35 nations [21]), HTR-PM (a new type of high-temperature gas reactor commissioned recently in China [22]), and ARTES (the satellite-based capital projects developed by the European Space Agency [23]).

Despite the relevance of science-driven capital projects in creating social value and enabling companies to claim it, two main literature gaps should be addressed:

1) In academic literature, very few studies have examined the role of science-driven capital projects in social value creation. They lack a comprehensive understanding of their governance and whether and how companies could join them to claim the social value created.
2) In practice, this knowledge gap results in companies lacking the necessary guidelines and processes to harness these projects for social value creation and claimancy, thus reducing the potential benefits of these projects.

To this end, we investigate a science-driven capital project developed in the space sector: the International Space Station (ISS). Indeed, thanks to the market, technological and regulatory changes over the last 10-15 years, a growing number of science-driven capital projects developed in the space sectors are now accessible to organisations from other sectors than space (e.g., healthcare, consumer

goods, energy) [24], with scholars claiming that “all companies need a space strategy now” [25], and science-driven capital projects have now the explicit mandate of creating social value [26].

We adopted a two-stage research design. First, based on public documents and reports, we investigate the governance and social value of projects developed on the ISS, finding that social value is created through two classes of projects: "In-Space" and "On-Earth” projects. Second, we performed a thematic analysis of 18 semi-structured interviews with senior managers from non-space companies that developed projects on the ISS. We design a roadmap for companies to create and claim social value by joining the governance of science-driven capital projects.

Our paper contributes to the theory by explaining how science-driven capital projects create social value and their key governance elements. We contribute to practice by clarifying to managers the main governance elements to be considered to create and claim social value through capital projects in the space sector. We show that space is rapidly evolving, becoming accessible to many non-space companies and offering a favourable context to create and claim social value. We provide managers with a roadmap and recommendations to create social value by joining the governance of science-driven capital projects.

2. Background

2.1. Social value claimancy

Since Starr’s [8] seminal research, a considerable debate has been ongoing on social value claimancy [9], [27]. Social value is multidimensional, including the individual perspective [28] and the societal one [29]. For example, the Apollo capital projects inspired young generations to pursue studies and careers in STEM domains, enabled new technologies development and job opportunities, creating multidimensional value for society. Social value can be subjective or objective. Psychological and organisational scholars call for the subjectivity of social value [30], meaning different stakeholders

have different value perceptions [31], [32]. For example, the Apollo capital projects created jobs, new technologies and inspired future generations, but also cost the 2020 equivalent of $257 billion to American Taxpayers. Economic scholars argue that social value is objective [33], and can be measured [34]. For example, counting the number of patents generated in connection with the development of the Apollo capital projects. Finally, social value is both tangible [35] and intangible [10], the latter often difficult to measure [36]. For example, technologies created by science-driven capital projects (e.g., CAT scans, adjustable smoke detectors, insulin dispensers) are tangible outputs, while the knowledge acquired by the 400,000 people who worked on the Apollo is intangible.

The dichotomy between economic and social value creation has been a focal point of academic discourse in the field of corporate strategy [10], [35] and social responsibility [9], [37]. Since the establishment of these fields, assuming that companies are “artificial persons” and thus cannot have responsibilities, scholars argue that the sole responsibility of a business is to increase its profits [38], thereby advocating that companies should focus on economic value creation [35]. This thesis is supported by the fact that social value is difficult to measure [30], often leading companies to waste money on projects without receiving any return or to engage in greenwashing and social washing practices [39], [40]. In stark contrast, proponents of Stakeholder Theory and Corporate Social Responsibility (CSR) assert that businesses have to contribute positively to society, emphasising the creation of social value [41], [42]. This debate has matured over time, but still, we can observe traits of one position or the other in the ongoing debate [43]. Recent scholarship, however, has sought to bridge the gap between these divergent views, proposing integrative frameworks that emphasise the symbiotic relationship between economic and social value [10], [44], [45]. Scholars argue that a company's competitiveness and the benefits for its stakeholders are mutually dependent [28], [46]. This perspective highlights that economic and social objectives are not mutually exclusive but can be pursued concurrently to drive business success and societal well-being [47], aligning with stakeholders' evolving expectations, who demand that businesses contribute to the broader societal good while also delivering economic returns [40].

In this regard, several methods and tools have been developed to measure social value [48], such as Cost-Benefit Analysis [37], Social Accounting [49], Social Return on Investment [50], Triple bottom line [44], SDGs impact assessment [51], [52], Sustainability reporting [9], Corporate Social Responsibility reporting [41], Environmental Social and Governance reporting [6]. Despite this array of methodologies and tools, no single method has been universally recognised as the industry standard for measuring social value [9]. Consequently, this lack of a universal standard has led many companies to use these terms interchangeably over time, contributing to confusion and inconsistency in how social value is reported and understood [6]. For example, what one company might categorise as a CSR initiative, another might record as an ESG effort, environmental impacts may be listed as social value and vice-versa, companies may have to start publishing CSR reports now become ESG reports. For the sake of clarity, in our paper, we refer to ESG reporting, acknowledging its broader scope in social value claimancy, compared to, for example, CSR and Sustainability methodologies, and recognising its widespread adoption. Table 1 presents the main standards for social value claimancy.

Social value Claimancy Standard	Developing Institution	Key Dimensions	Reference
Global Reporting Initiative (GRI)	Global Reporting Initiative	Economic, Environmental, Social	www.globalreporting.org
Sustainability Accounting Standards Board (SASB)	Sustainability Accounting Standards Board	Industry-specific sustainability metrics	www.sasb.org
United Nations Global Compact	United Nations	Human Rights, Labour, Environment, Anti-Corruption	www.unglobalcompact.org
ISO 26000	International Organization for Standardization (ISO)	Governance, Environment, Labor Practices, Human Rights, Fair Operating Practices, Consumer Issues	www.iso.org
Carbon Disclosure Project (CDP)	Carbon Disclosure Project	Climate Change, Water, Forests, Supply Chain	www.cdp.net
Dow Jones Sustainability Index (DJSI)	S&P Dow Jones Indices	Economic, Environmental, Social	www.spglobal.com/esg/csa
Task Force on Climate-related Financial Disclosures (TCFD)	Financial Stability Board	Climate-related Financial Risk and Opportunities	www.fsb-tcfd.org
Equator Principles	Financial Institutions	Environmental and Social Risk in Project Finance	www.equator-principles.com
Ceres Principles	Ceres	Corporate Strategy, Governance, Stakeholder Engagement	www.ceres.org/principles

Social Accountability 8000 (SA8000)	Social Accountability International	Child Labor, Forced Labor, Health and Safety, Freedom of Association and Right to Collective Bargaining, Discrimination, Disciplinary Practices, Working Hours, Compensation	www.sa-intl.or

Table 1 - Main standards for social value claimancy

2.2. Science-driven capital projects governance

Project governance provides a framework for ethical decision-making and managerial action within an organisation, grounded in principles of transparency, accountability, and clearly defined roles [53]. This framework ensures that decisions are taken in a manner that aligns with the organisation's strategic goals of creating economic and social value [54]. Governance encompasses the value system, responsibilities, processes, and policies that guide projects towards achieving organisational objectives[55]. It fosters implementation practices that serve the best interests of stakeholders and ensures that the organisation operates efficiently and ethically [56].

In simple terms, governance defines organisational goals and the means to achieve them, outlining the processes managers should use to run their areas of responsibility effectively [57]. By delineating the ownership and control of tasks, governance clarifies responsibilities and sets the boundaries for management actions [58]. Governance is inherently multidimensional and can be applied across various levels of analysis, including system or sector governance, corporate governance, portfolio governance, program governance, project governance, and team governance [59]. Each level requires tailored governance structures and interfaces to address specific value creation objectives [60]. Literature extensively discusses governance interfaces at different levels, from the individual level [61] to the inter-organisational network [62]. Despite the diversity of approaches, there is a consensus that the study of governance interfaces is context-specific [63] and can be generalised by referring to the actors' responsibilities, formal and informal routines, roles, and relationships [59].

Capital projects consist of a complex network of organisations spread across multiple supply chain tiers, each contributing their specific expertise to the project [56]. Scholars discussed project

governance using a variety of interchangeable and often confusing terms to describe the roles of the organisations in the development of capital projects, such as the owner [64], owner and operator [65], sponsor [66], and contractor [56]. Capital projects typically include at least one owner (an organisation that owns the asset to be developed in the project) who may also serve as both sponsor (an organisation that invests money to develop the asset) and, eventually, operator (an organisation that operates the asset after the project completion), and a prime contractor (an organisation developing the asset and managing the project) with its subcontractors.

As anticipated in the Introduction, the literature distinguishes between two main capital project groups: infrastructure-driven and science-driven capital projects [17]. Infrastructure-driven capital projects are subjected to path dependency [67], which includes strong interdependencies with the existing systems [68], the need to follow regulations and technical standards [69], and the existence of previous knowledge and learning economies [58]. Therefore, path dependency may limit service capital projects' value creation and distribution. An exemplar case is, in the nuclear sector, the usage of PWR technology. During the '50s and '60s, the USA and USSR governments strongly supported such technology because of its double use in civil (electricity production) and military (marine propulsion). Even if other nuclear technologies are more suited for electricity production, path dependency on PWR is demonstrated by having 48 of the 56 nuclear power plants under construction as PWR reactors [70]. Science-driven capital projects are far less subject to path dependency, and project sponsors and owners can design the value creation and distribution with fewer constraints than service capital projects. Governments and public institutions are often founders and sponsors of science-driven capital projects, because such projects are fundamental to creating and distributing social value, fostering industrial growth and shaping people's lives [63]. For example, the European Council approved the investment of €23 billion to promote the development of new technologies and applications to tackle climate change and promote the climate transition [71]. Governments and public institutions, on the one hand, may contract or subcontract the development of science-driven capital projects to private organisations. On the other, they could allow private organisations to use

the infrastructure developed through the science-driven capital project to develop research projects and technology development. In both cases, private organisations can create social value. Therefore, organisations interested in creating social value may leverage science-driven capital projects.

3. Empirical setting: the International Space Station in the New Space Economy

The space sector rapidly changed over the past 10 years, with businesses, agencies and public institutions calling for its revolution [24]. Morgan Stanley estimated that the yearly revenue generated by the space industry may be more than $ 1 trillion by 2040 [72]. Companies, either incumbents or non-space firms, are attracted by new opportunities and the potentially enormous social value created by space programmes [26]. Scholars recently claimed that each company needs a "space strategy, now" [25]. Space capital programmes and projects create social value and are becoming essential to addressing planetary challenges, including food scarcity, industrial development, and climate change [73]. Participating in the governance of space capital projects could be a unique opportunity for many organisations to create long-lasting social value [24]. For example, the Apollo programme, initiated by the U.S. in 1961, enabled thousands of privately led projects that radically improved our lives, as exemplified in Table 2. This was at a time when the space sector was relatively closed, and "non-space companies" had few chances to join those projects.

Project	Description	Social value created
Water purifier	Developed by Caribbean Clear Inc. in 1994. Starting from NASA's silver ion technology has been used to create an automatic pool purifier as an alternative to chemicals such as chlorine and bromine. Purifiers use silver ions in Apollo Purification Systems to kill bacteria, copper ions and algae.	This technology has been improved and commercialised by several companies worldwide, contributing to the growth of the $22.92 billion (in 2021) water purifier market [74] and reducing diseases such as diarrhoea, dysentery, typhoid and polio caused by drinking contaminated water (2 billion people use a drinking water source contaminated with faeces [75] causing 485.000 deaths yearly).
Shocking heart monitoring	In 1980, NASA's Apollo technology was used by Medrad to develop the AID implantable automatic pulse generator [76], which monitors the heart continuously, recognises the onset of a heart attack and delivers a corrective electrical shock. The	This technology enabled the development of implantable cardioverter-defibrillators, reducing by 23% to 36% the risk of sudden cardiac death, creating social value for the

	pulse generator is a miniaturised version of the defibrillator used by emergency squads and hospitals to restore rhythmic heartbeat after fibrillation.	nearly 200,000 people yearly with the defibrillator implanted [77].
Automated insulin medication	In 1977, for the Apollo projects, NASA and Parker Hannifin Corporation developed the Programmable Implantable Medication System (PIMS) for continuous, computer-directed delivery of precisely metered medication. The technology was adopted to design insulin pumps, enabling automated insulin administration.	Nowadays, insulin pumps are used by more than 1.15 million people worldwide, improving the lives of people with diabetes and reducing its mortality (6.7 million deaths due to diabetes in 2021 [78]).
Dialysis machine	Marquardt Corporation developed the research project in 1992. The project involved developing a chemical process to remove toxic waste from the used dialysis fluid. This discovery led to the development of a kidney dialysis machine using "sorbent" dialysis, a method of removing urea from human blood by treating a dialysate solution.	This enables the development of treatments for more than 2 million people worldwide who suffer from kidney failure, and the number of patients diagnosed with the disease continues to increase at a rate of 5-7% per year [79]. In the United States, nearly 570,000 Americans receive dialysis in a population of 810,000 patients with kidney failure.

Table 2 - Examples of social value created by space projects related to the Apollo programme

Thanks to market, technological and regulatory changes over the last 10-15 years, the space sector is now becoming accessible to many non-space organisations able to afford the investments in space-based infrastructures and services [25]. For example, in the recent commercial space project Axiom3, several non-space companies supported by the Italian Space Agency and the Italian Air Force benefit from experimentation on the International Space Station, such as the health-tech startup Mental Economy, supported by PwC Italy, which tested a mental performance training protocol for individuals in highly stressful and competitive environments. Dallara, an Italian automotive company, measured the shielding capacity and effects of radiation on advanced materials to be used on vehicles down to Earth and space flights. Barilla Group, a leading food company, developed a ready-made pasta, contributing to the development of a broader range of foods for space and Earth [80]. This was possible thanks to the ongoing shifting of the space sector from the “Old Space” to the “New Space”. We juxtapose the "Old Space" paradigm, typical of the '60s and '70s (e.g., the Apollo projects), with the "New Space" paradigm that emerged in the early 2010s (e.g., the Artemis Space Programme) [81]. This transition is relevant to our discussion for two main reasons, as detailed in Table 3.

	Old Space	New Space
Social value as space capital project primary goal	**Social value was not the primary goal or, at least, wasn't explicitly mentioned**. E.g., the Apollo capital projects' goals were "*Establishing the technology to meet other national interests in space*" or "*Achieving pre-eminence in space for the United States*" [82]	**Explicit and primary goal of creating social value**. E.g., Artemis capital projects aim to "*Promote the sustainable and beneficial use of space for all humankind*" [83].
Governance of space capital project	**Space capital projects were funded entirely by governments** to advance national superiority and strategic position in space [84]. **Space agencies were seen as the primary contractors and exclusive customers of space technologies and assets** [85] and retained full ownership of space assets and technologies [84]. Private organisations only participated in project governance as contractors for space agencies.	**Open to new, often "non-space", organisations.** New actors, both private and public, are providing space-based applications and services [24], looking at the space sector as a source of innovation [86] for sustainable development [87]. For example, to develop water mapping technologies, chlorophyll meters detecting plant stress, fuel-cell engines, and biosensors to test for pathogens.

Table 3 - The transition from "Old" to "New" Space in fostering social value creation

We discuss the social value creation and claimancy of organisations joining the governance of a particular science-driven capital project: the International Space Station (ISS). The ISS is a capital project conceived by the United States in the '90s to develop a permanent outpost in Low Earth Orbit. The ISS consists of a large spacecraft in orbit around Earth that can support a crew of six people and visitors performing experiments in outer space conditions. The ISS consists of 16 modules developed by ISS partners: 8 U.S. modules, 6 Russian modules, 1 Japanese module, and 1 European module. The ISS project costed so far $150 billion, including annual operational expenditures of $3 billion [88]. In 2022, NASA committed to replacing the ISS with one or more commercially owned and operated space stations by 2031 [89] to continue long-term space human exploration missions and access to a research laboratory in low Earth orbit. Spanning the area of a football field, the ISS carries an impressive array of research facilities supporting projects across every major scientific discipline. The ISS provides researchers with unique features such as long-duration microgravity, exposure to space, and a unique perspective on our planet. As further explained in Section 5, space and non-space companies can join the governance of the ISS and develop projects to create and claim social value. Since the ISS is in operation, more than 3,300 "In-Space" and "On-Earth" projects have been planned

and delivered because of the ISS [90], enabling research and technology development for more than 4,200 researchers in 108 countries [88].

4. Methodology

We adopted a two-stage research design to investigate how companies create and claim value by joining the ISS governance (Figure 1). Each stage employed distinct data collection and analysis methods to develop and validate a roadmap for managers to join the governance of capital projects to create and claim social value.

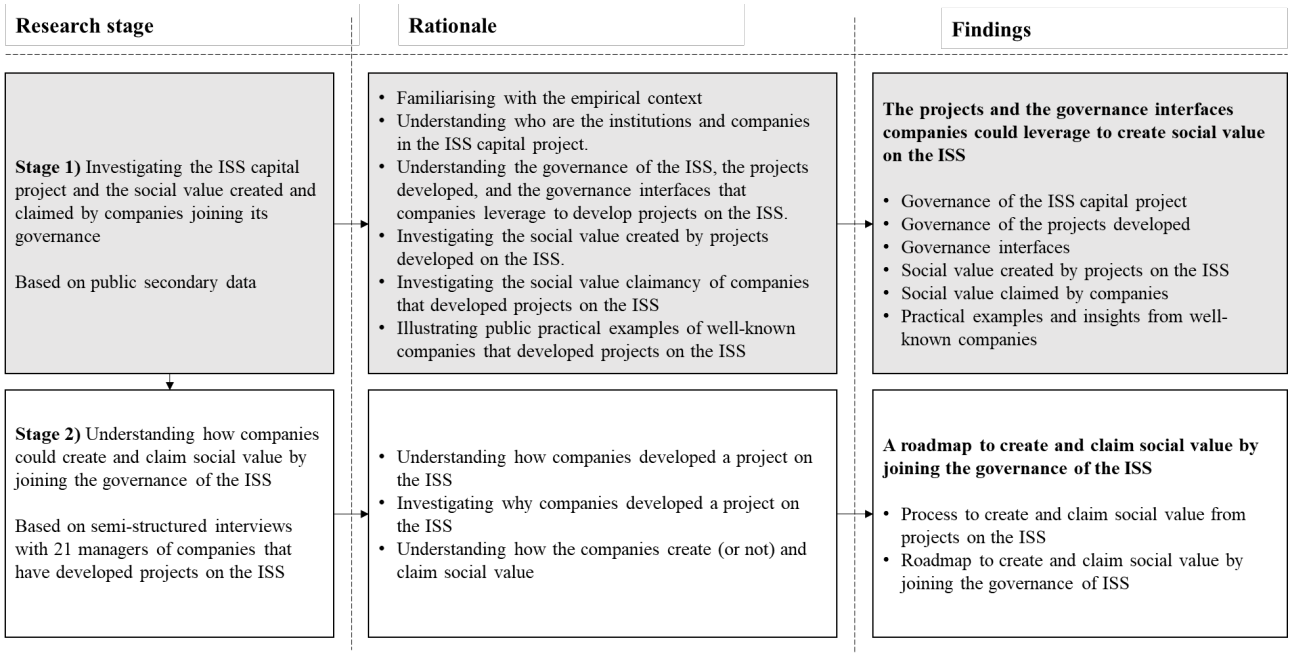

Figure 1 - Research Design

4.1. Stage 1: Investigating the ISS capital project and the social value created by companies joining its governance – based on secondary data

The first stage of our research aimed at familiarising ourselves with the empirical context of the ISS capital project, identifying the institutions and companies involved, the formal governance of the ISS and the governance interfaces that companies adopt to develop projects on the ISS. This stage also serves as the basis for understanding the social value created by these projects.

Data collection was based on secondary data consisting of public documents, websites, reports and video interviews distributed by the organisations participating in the ISS, and news in magazines and newspapers. We opted for secondary data, given their vast accessibility and public availability [91]. The adopted snowballing data collection [92] starting from the "ISS Benefits for Humanity" [93], "NASA's Management of the International Space Station and Efforts to Commercialise Low Earth Orbit" [88] and "NASA Plan for Commercial LEO Development" [94] reports that describe in detail the governance of the ISS and projects developed by non-space companies with explicitly mention the social value they create. Furthermore, we collected data on projects developed on the ISS starting from the "List of current space agreements", which provides a list of more than 1300 projects developed between private companies and NASA [95]. Then, we collect the reports and articles mentioned by these starting sources and deepen the governance and social value of projects developed on the ISS. We excluded projects that were developed on the ISS or lacked evidence regarding the social value created. Furthermore, we visited the non-space companies' websites that were mentioned in these sources and downloaded their ESG reports from 2023 to (when available) 2003. We also triangulate the data by searching for news in newspapers mentioning the projects developed by these companies and their social value claimancy. For example, the report ISS Benefits for Humanity" [93] mentioned on page 11 a project developed by Procter & Gamble (P&G, we searched for further details of this project on the ISS national lab project public database (that was a data source mentioned in the report), search on P&G projects (e.g., [96]), we then look at the P&G ESG reports published on their website and search for a description of the project (e.g., [2]) and newspaper articles describing it (e.g., [97] published on Forbes) and video interviews describing the project published on YouTube (e.g., [98]). Overall, we analysed 204 documents and interviews (Table 4 in Appendix). We stopped the data collection once we obtained the data saturation, meaning that additional data no longer contributes new insights or information to describe the governance and social value created and claimed. [99]

We analyse our data by resembling our empirical insights to the theoretical governance framework developed by Denicol et al. [56]. The first author designed a preliminary governance framework for the ISS and the projects developed on it, clarifying the stakeholders involved, their responsibilities and roles and governance interfaces. All the authors discussed and refined the framework. Furthermore, we abductively analyse [100] the reports to retrieve patterns regarding the form of social value created and claimed and the process used by companies to develop their projects on the ISS, particularly the distinction between the governance "Space" and "Earth" projects and the governance interfaces. We then conducted a cross-project analysis to observe similar and polar patterns of the elements of project governance that influenced the social value created and claimed [101]. Findings were validated during the interviews developed in stage 2.

Finally, we selected and discussed four relevant cases of companies that created and claimed social value by joining the governance of the ISS, with the scope of illustrating to the readership public practical examples of well-known companies that developed projects on the ISS. Following Martinsuo and Huemann [102], we performed a multiple case study [103], [104]. We identified A) Target Corporation – ISS cotton sustainability challenge, B) the Procter & Gamble Tide – Cleaning in Space, C) Hewlett Packard Enterprise - Spaceborne Computer-2, and D) Goodyear Tire & Rubber Co. – Tyre material. All the cases are projects developed in the ISS that created social value, claimed in ESG reports by companies. These cases were chosen based on three main criteria that are proper for multiple case studies: 1) polarity, presenting two polar governance interfaces for joining the governance of ISS capital projects (i.e., space projects and earth projects) and showcasing different non-space industries. 2) Similarity, all these cases follow the roadmap defined in research stage 2. 3) accessibility to public data. To make accessible and transparent the social value created and claimed and to disclose the names of these companies and projects, we decided to base these cases only on public secondary data. None of the informants interviewed in stage 2 belong to the companies selected. The data collection and analysis for each project resemble the one described above.

4.2. Stage 2: Understanding how companies could create and claim social value by joining the governance of science-driven capital projects - based on primary data

The findings of stage 1 provided a foundational understanding of the ISS capital project's governance and social value aspects, serving as inputs for stage 2. In this stage 2, we investigate how and why companies join the governance of the ISS to create and claim social value.

The data collection relied mainly on primary data. We conducted semi-structured interviews with 18 senior managers from companies that have developed projects on the ISS (see the list of interviewees in Table 5 in the Appendix) to obtain deeper insights into the governance mechanisms leveraged by companies to develop projects on the ISS, and the processes to create and claim social value (see the semi-structured interview protocol in Table 6 in the Appendix). We adopted two consecutive sampling strategies, one for the company and one for the manager working in it. We select companies resulting from the analysis of stage 1. We adopted a theoretical sampling and included non-space organisations who have developed projects on the ISS and have claimed it in their ESG reports. This guarantees theoretical saturation [99]. We selected interviewees through purposive sampling [105], [106] according to their job content and experience developing projects on the ISS. The interviews lasted, on average, 55 minutes. All the conversations took place online via MSTeams, and all the interviewees and organisations were granted anonymity [107]. We triangulated the interviews with secondary sources to guarantee the reliability and consistency of our results. For example, if managers mentioned a stakeholder in the project, we looked for this stakeholder in the secondary data sources collected. All interviews were transcribed verbatim.

We performed a thematic data analysis following the Gioia Methodology [108], which is particularly suitable for inductive research aimed at theory building, as it emphasises the importance of capturing informants' terms and meanings (first-order concepts) and systematically transforming these into theoretical constructs (second-order themes and aggregate dimensions) [108]. The findings are summarised in Figure 2. See in the Appendix Table 7 for the full list of codes. We performed the

first-order coding to preserve the perspectives of the informants as closely as possible. An example of an in vivo label from our data is "Engaging with intermediaries to explore business opportunities". Then, these first-order codes were grouped into broader second-order themes. For instance, the first-order concept of "Engaging with intermediaries to explore business opportunities" with the codes “Scouting science-driven projects opportunities” and “Leveraging your personal and organisational network to understand the space sector“ were aggregated to the second-order theme, "Identifying existing and future capital projects". These second-order themes were then aggregated to the main themes. For example, "Familiarising with capital projects and social value" represents the first step companies adopt to eventually join the governance of capital projects to create and claim social value. The findings become the key dimensions of the roadmap we developed to explain how companies joining the governance of science-driven capital projects can create and claim social value [109].

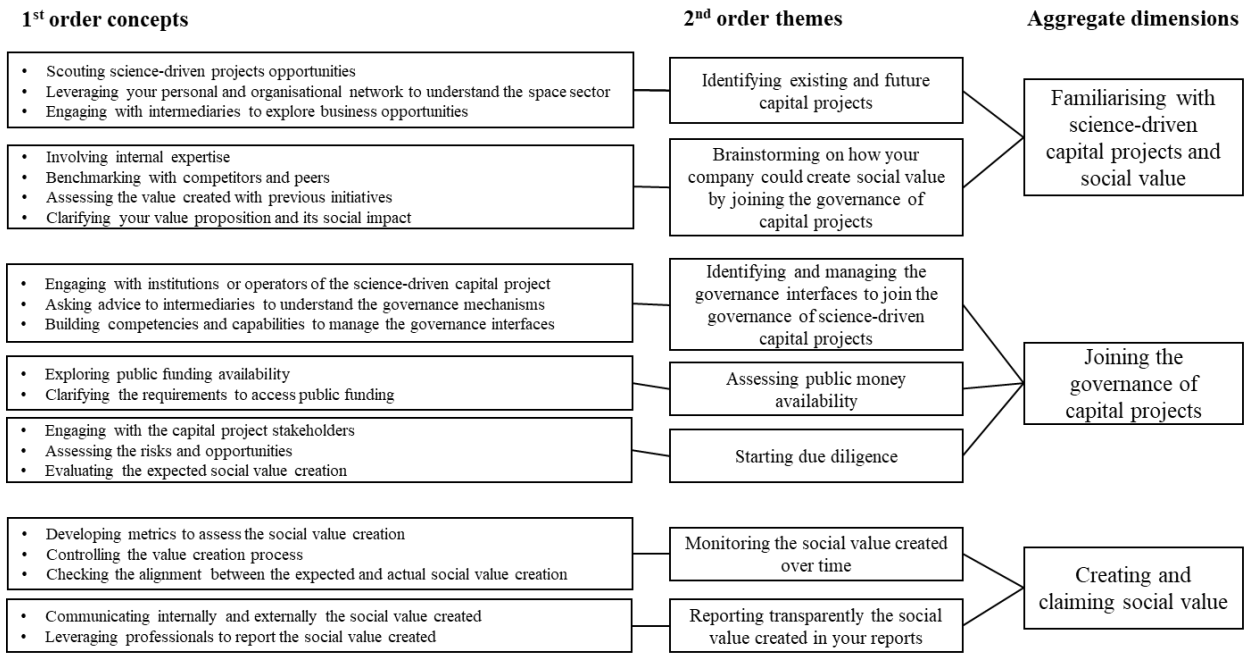

Figure 2 – Gioia data analysis

5. Findings

5.1. The governance elements to be considered to create social value on the ISS

We identified three main elements of governance that companies should consider to create and claim social value by joining the governance of the ISS (Figure 3).

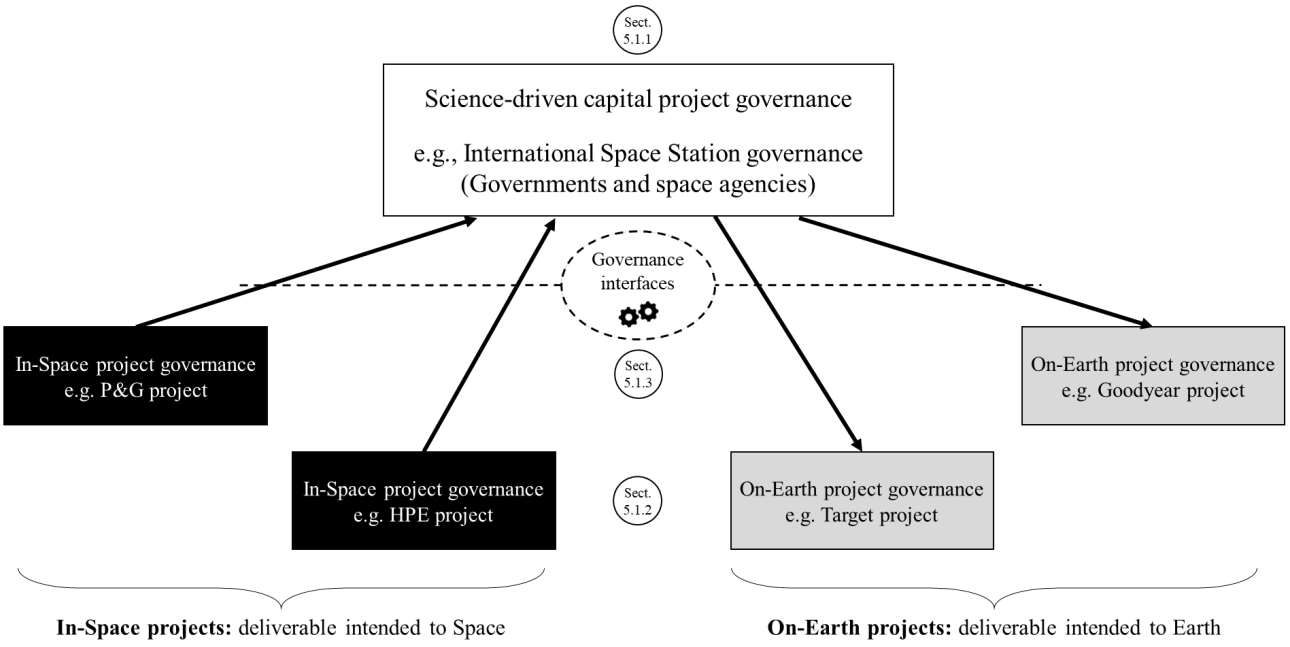

Figure 3 - ISS governance elements to create and claim social value

5.1.1. The ISS Governance

First, the International Space Station (ISS) governance. Governments and space agencies demand the governance of the ISS according to 5 criteria. 1) Governments designing, developing and operating the ISS are partners. 2) NASA is the ISS's orchestrator (called "manager" in the agreements). 3) ISS partner governments retain jurisdiction, ownership and control over the components (e.g., laboratories enabling "In-Space" and "On-Earth projects") they register on the ISS [110]. 4) ISS partners providing components (e.g., laboratories) retain the use of them. 5) ISS partners can allow private organisations to use their components for "Space" and "Earth" projects on the ISS.

5.1.2. “In-Space” and “On-Earth” projects

Second, the ISS serves as a platform [111] for projects whose governance can also be demanded by private organisations. Those projects are distinguished into two classes of projects, "In-Space” and "On-Earth” projects.

In-Space project deliverables are intended to function in space (e.g., the development of the ISS Columbus module). Space projects enable the existence and continuous transformation of the ISS. Thousands of In-Space projects have been developed to contribute to the ISS capital project (e.g., building the modules constituting the ISS, developing facilities and laboratories on board the ISS, and developing tools and products for astronauts, like heartbeat monitoring systems). In-Space projects enable the development of knowledge and technology, creating social value. Usually, In-Space projects generate the fundamental scientific knowledge that will be exploited (often years or decades later) to develop technologies such as insulin pumps, water purifiers, and implantable heart monitoring systems. Organisations joined the governance of In-Space projects when they had the capabilities to contribute to research or to manufacture products that were functional to the existence and continuous transformation of ISS and its crew. Below, we present the social value and the governance of two recent and relevant In-Space projects developed on the ISS.

A) Procter & Gamble Tide – Cleaning in Space

In 2020, Procter & Gamble (P&G) signed a Space Act Agreement to explore how to efficiently clean astronauts' clothing in resource-constrained environments [1]. Ingredient safety and compatibility with NASA life support systems are significant issues for off-Earth laundry, as is the restricted amount of water available each wash load and the need to be processed back to drinking-quality water. Tide, a P&G laundry brand, created a totally biodegradable detergent designed for use in space to handle malodour, cleanliness, and stain removal for washable objects used during deep space missions, while also being safe for use in a closed-loop water system. This has on-planet implications like innovative solutions for water and resource management, and environmental challenges, and

leading to new product development by P&G to improve people's lives on Earth. P&G claimed the social value created in its ESG report [2] by highlighting that they acquired knowledge to develop better environment-friendly products which may have a considerable impact on people's lives, as stated, "*P&G is eager to learn how to clean effectively with less water to help protect our home planet*" [2, p. 25]. The social value created fosters P&G to continue with new In-Space projects to create social value: "*We* [P&G] *can't wait to continue exploring how to apply the results of these tests for laundry solutions on Earth and beyond*" [2, p. 25].

B) Hewlett Packard Enterprise - Spaceborne Computer-2

In 2021, Hewlett Packard launched the Spaceborne Computer 2 (SBC-2) space project on the ISS [112]. SBC-2 is a high-performance computing system designed for use in the harsh environment of space, including radiation exposure, which can cause errors in computing systems, and support a range of scientific experiments and research projects to be conducted in space. This includes experiments related to Earth images and climate modelling, gene sequencing, and communication processing. SBC-2 enables real-time data processing and analysis in space, leading to social value creation in many ways. For example, SBC-2 enables the assessment of Earth's traffic trends and the measurement of the level of emissions and other pollutants in the atmosphere. Municipalities and decision-makers can use this information in developing urban plans or land restoration, improving people's health and lives. SBC-2 creates social value by, for example, enabling real-time tracking of objects moving in space and the atmosphere, from planes to missile launches, and real-time image processing of a territory affected by a disaster, improving data reliability in case of emergency, supporting rescues and saving people's lives. Hewlett Packard claimed the social value created by supercomputers and computing facilities developed in space projects with NASA [113], highlighting the advantages in terms of energy efficiency fostering further developments on Earth: *"The improved supercomputers are built with fewer raw materials, have up to 95% fewer power losses, and optimise energy efficiency through real-time monitoring of computing loads as well as thermal and power aspects"* [113], p. 21].

On-Earth projects provide deliverables whose main application is intended on Earth. They use the ISS as a laboratory, for instance, for developing a new material or a vaccine in microgravity. All kinds of organisations can join the governance of On-Earth projects as there are no required space capabilities. Among many others, Procter & Gamble, Merck & Co., Adidas, Colgate-Palmolive, Nike, and Target Corp. have already joined the governance of On-Earth projects on the ISS [90]. Below, we present the social value and the governance of two of them.

C) Target Corporation – ISS cotton sustainability challenge

In 2018, in collaboration with the ISS National Lab, Target Corporation sponsored the "ISS cotton sustainability challenge" [3], providing researchers with grants to test their ideas for improving crop production and water sustainability on Earth using ISS. The project was recognised among Fast Company's World Changing Ideas of 2019 [114]. As reported in Target Corporation ESG report [4], cotton is an essential raw material for them, and the company is committed to " *leveraging the company scale to drive positive change within the cotton industry by sourcing 100 per cent sustainable cotton for our owned-brand and exclusive national-brand products"* [4], p. 41]. The company recognised the social value created by collaborating with the ISS by "improving water sustainability on Earth". Besides, the company understands the social value this project can create, as the ESG report claims: "*We hope that the research will lead to breakthroughs and collaborations that enhance overall cotton sustainability*".

D) Goodyear Tire & Rubber Co. – Tyre material

In 2018, Goodyear initiated a project on the ISS to study silica, a critical mineral in producing consumer tyres, to reduce the "resistance" generated as tyres roll along the road [115]. In typical automobiles, 5% to 15% of the fuel consumption is used to counter this rolling resistance [116]. Goodyear specifically investigated if silica particle creation in microgravity can disclose novel molecular structures that can be exploited to improve tyre performance. The experiment conducted by Goodyear paved the way for creating consumer tyres that are more fuel-efficient and reliable than

those now on the market. Goodyear claimed the social value created by this project in its ESG report [117]. The new material studied on the ISS enables Goodyear to create social value by "*gaining knowledge*" [117], p. 32] to reduce production's environmental impact and increase tyres' safety. Moreover, they claim the value of this On-Earth project as the first step "*to further study of materials performance and continue innovating for tyre enhancements*" [117], p. 32].

5.1.3. Governance interfaces

From our analysis, three key governance interfaces enable companies to join the governance of the ISS and create and claim social value.

First, Space Agencies directly engage companies through tenders to develop In-Space and On-Earth projects on the ISS. Tenders are typically used to foster In-Space projects as the agencies seek industrial expertise to develop the ISS further, but they are also used for On-Earth projects. The private organisation selected receives a grant (mission-specific order [118]) and develops the project as a contractor of the space agency. A case in point is ESA awarding QinetiQ, a U.K. space company, a grant worth €8.5m for developing and producing microgravity-based heat transfer experiments on the ISS [119]. Also, NASA recently awarded Collins Aerospace to develop new space suits for astronauts on the ISS [120]. European organisations can participate in the tender through the ESA portal "esa-star" [121]. American organisations can follow NASA Research Announcements [122]. Japanese organisations may follow the JAXA business development and industrial relations directorate [123].

Second, a Space Agency and a private company may partner to develop In-Space or On-Earth projects. They negotiate and sign an agreement, which could include or not payments. Usually, private organisations retain ownership of the project outcomes, and the risks are shared between the Space Agency and the private organisation. This is the case of Newport News Public School District,

which signed an agreement with NASA to fabricate storage lockers for the ISS [124]. For NASA, this governance mechanism goes under the "Space Act Agreements" umbrella that can be signed with national and international parties. In its broadest context, "agreement" includes any transaction the Space Act authorises NASA to conclude (i.e., contracts, leases, grants, cooperative agreements, or other transactions). Agreements establish a set of legally enforceable promises between NASA and the private organisation requiring a commitment of NASA resources (including goods, services, facilities, or equipment) to accomplish the project objectives.

Third, Governments and Space Agencies have constituted intermediary organisations to promote the development of development projects onboard the ISS. In the 2000s, the U.S. government instituted and charged the ISS National Laboratory with "promoting and brokering a diverse range of research in life sciences, physical sciences, remote sensing, technology development, and education" [125] on the ISS. The ISS National Lab provides private organisations with a wide variety of research equipment for enabling R&D and technology development, offers information and procedures to apply for In-Space and On-Earth projects, and promotes and funds research competitions, investment opportunities, STEM education programs, and commercial services opportunities. Private organisations can participate in solicitation calls, offering solutions and ideas to the challenges launched by the ISS National Lab [126]. For example, in 2022, ISS National Lab launched a call to solicit proposals for applied R&D seeking to demonstrate space-based bio-manufacturing activities in microgravity [127].

5.2. A roadmap to creating and claiming social value by joining the ISS governance

Our research aims to explain how companies can create and claim social value by joining the governance of science-driven capital projects. To this end, clarified projects that companies could develop on the ISS (i.e., In-space and On-Earth Projects) and the governance interfaces to consider,

we now present a roadmap resulting from our analysis to create and claim social value by joining the ISS governance (Figure 4).

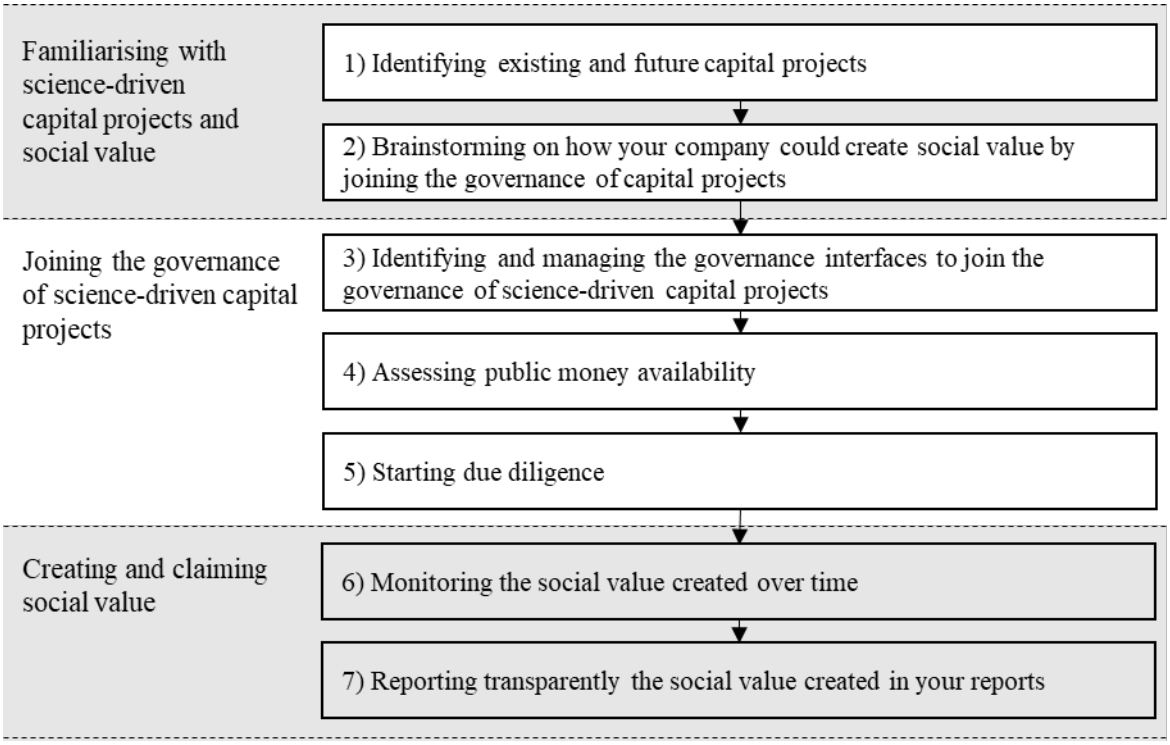

Figure 4 - Roadmap to create and claim social value by joining the governance of science-driven capital projects

The roadmap consists of seven stages that companies should follow. These stages resemble three main conceptual steps: 1) familiarising with science-driven capital projects, 2) joining the governance of science-driven capital projects, and 3) creating and claiming social value.

Since companies may not be familiar with science-driven capital projects and the social value they create, companies have first to familiarise themselves with the context. To do so, they have to

1) *Identifying existing and future science-driven capital projects*. Interviewees highlight the relevance of scouting science-driven capital projects opportunities that "are somehow related to [their] business and could create social value aligned with the company's values and strategy" (Int 3). In doing so, managers should leverage their personal and organisational networks to understand capital projects and the sector in which they are developed. "We are an energy company, in theory, unrelated to space. Yet, some colleagues developed advanced

solar panels based on technologies developed for outer space. The first thing I did, before experimenting on the ISS, I asked colleagues for support, and their opinion" (Int 16). Another practice that resulted effectively is the engagement with intermediaries who "are able to explain you, in your language, what can be done and what can't be done" (Int 15), but, more important, "make you in contact with possible partners able to complement company's expertise and need" (Int 8).

2) *Brainstorming on how your company could create social value by joining the governance of capital projects.* Once understand the existing and future opportunities, managers brainstorm internally and try to design possible projects that can create social value in line with the company's values, strategy, and capabilities. Interviewees remark on the relevance of engaging internal expertise if available "I built an internal working group with managers from several departments to brainstorm and discuss if developing projects on the ISS was aligned with our goals" (Int 2). It also implies benchmarking a company's capabilities and strategy with competitors or similar companies that have already developed projects on the ISS o did something similar in other science-driven capital projects. Extremely relevant is the assessment of the social value claimancy of competitors by studying their ESG reports and public statements: "We observed that one of our main competitors was developing and claiming the social value created by the vaccine-development experiment they developed on the ISS; it had strong media coverage and outreach. It was for sure an incentive to start projects on the ISS" (Int 15). Furthermore, managers should clarify internally their value proposition and its social impact so as not to waste resources and time and not appear as a green-washing initiative: "We studied in depth the potential risks and opportunities in terms of social value creation to be sure the project development was effective and aligned with our values" (Int 14).

After the opportunities identification and assessment, companies should understand how to join the governance of science-driven capital projects such as the ISS. In doing so, from our data emerges that companies should

3) *Identifying and managing the governance interfaces to join the governance of science-driven capital projects.* Governance interfaces consist of grants and contracts provided by public institutions managing these capital projects, partnership agreements between public institutions managing capital projects and the private organisation, and intermediary organisations supporting private organisations in joining the governance of capital projects. Companies should engage with institutions to "understand the resources needed and the requirements to start projects on the ISS" (Int 1) as well as intermediaries who "could facilitate the entrance in the governance, especially if you are not a space company" (Int 9). Particularly, Managers should understand if they want to create social value as a "supplier" (In-Space projects like), by providing their resources and capabilities to enable the capital projects, or a "user" (On-Earth projects like), by using the infrastructure to create social value. To this end, companies have to build internal capabilities and competencies if not available.
4) *Assess public money availability.* Since joining the governance of science-driven capital projects may be risky and not guarantee an economic return. Public institutions support companies with fund grants, open calls, partnerships or agreements, acting as sponsors, as they recognise the potential of capital projects in creating social value. Therefore, companies should explore public funding availability by "participating in informative and networking sessions (Int 17) and clarifying the requirements to access these fundings "we carefully studied how to access NASA funding and the requirements because space is not our sector, and rules are completely different" (Int 4).
5) *Start due diligence.* Once the governance interfaces are clarified, as well as the money availability assessed, companies should start due diligence to decide whether or not to join the governance of capital projects. In doing so, interviewees explain the importance of

engaging with the ISS stakeholders: “You have to engage and negotiate, when possible, with the Space Agency as well as the companies supporting you in developing the project. It requires time and resources, but, even if it is not rocket science, it is fundamental to minimise future risks and costs, and maximise the expected social value creation” (Int 11). Risks and opportunities assessment is the turning point to join or not the governance of the ISS, especially if you are not a non-space company, indeed, “risks are very high and the benefits difficult to predict if you have not expertise in the sector, in this case, the assessment of risks mitigation strategies become vital” (Int 18). Here, is fundamental the assessment of the expected social value the project could create. Interviewees highlights that: “to grasp the nuances of social value, it is necessary to involve all the key decision-makers in the organisation. Even if it may be challenging and time-consuming, it can’t be only an exercise for the social responsibility manager or unit” (Int 2).

If the due diligence has a positive outcome, companies will start the project on the ISS, aiming to create and claim its social value. The findings suggest that two main steps are necessary to achieve this end.

6) *Monitoring the social value created over time.* Indeed, social value is multidimensional and may change over time. To effectively measure, and therefore claim it, companies should develop metrics to assess the social value created “based on the existing ESG standards, adapted, if necessary, to the specificity of the project” (Int 12) and a way that “aligns with the companies sustainable goals” (Int 16). Value creation should be monitored over time and, if necessary, actions to guarantee the alignment between the expected and actual value should be performed, such as “engaging periodically with the space agency and the ISS service providers to be sure the project outcomes align with company’s expectation” (Int 1). The alignment between the expected and social value has been identified as one key aspect to be

considered as “joining the governance favour as the company developing the project has the right to implement corrective actions in case of misalignment” (Int 14).

7) *Reporting transparently the social value created in your reports.* Once the social value is created, it has to be claimed in the company’s reports. Interviewees highlight that first of all, since these kinds of projects require the engagement of several members of the company, it is necessary to communicate the social value internally by “organising internal events to show the results, including the project description in the company’s newsletter, and asking for feedback from employees” (Int 10), as well as communicating effectively externally, “because you experiment with the outer space it doesn’t necessarily mean it creates social value or that people understand it, you have to communicate practical results supported by figures” (Int 18). Since there is not a single standard to report social value, especially for science-driven projects, that nowadays appear under investigated and underexploited, interviews state the importance of leveraging “experts to report the social value create, so that the social value created and the role of the company could be properly described and understood by the stakeholders and society” (Int 7).

6. Discussion and Conclusions

Our research explains how companies can create and claim social value by joining the governance of science-driven capital projects. By investigating the International Space Station (ISS) science-driven capital project in the space sector.

We contribute to the theory by examining the role of science-driven capital projects in social value creation. We offer scholars a comprehensive understanding of the science-driven capital project governance and governance interfaces [59] at the organisational level, highlighting the strong connection of governance interfaces for social value creation [60]. Our results offer empirical insights into the connections between the social value performance of projects and the companies [15],

confirming recent conceptual development calling for the reconciliation of these two dimensions when social value is created [5], [128]. Our research contributes to the social value creation and claimancy debate [10], [44], [45], showing empirically that the traditional tension between profit and sustainability can be overcome by joining the governance of science-driven capital projects. Indeed, from our analysis emerges that companies that develop these projects on the ISS pursue both economic and the social value creation, while the main scope is the social value creation and claimancy [7], [35]. Our results show the key role of engagement with stakeholders [129]. Future research mainly explores the proper engagement practices of scientific-driven projects.

We contribute to practice by showing managers that their companies could create and claim value by joining the governance of science-driven capital projects, describing the main governance elements to be considered to create and claim social value in the space sector. We show that the space sector is rapidly evolving and becoming accessible to many non-space companies and offers a favourable context to create and claim social value. Companies could develop both In-Space projects, such as the ones developed by P&G and HPE, or On-Earth projects such as the ones developed by Target and Goodyear.

Moreover, we offer managers a roadmap to create and claim social value by joining the governance of science-driven capital projects. The ISS case offers an excellent example of how organisations can create social value by joining the governance of science-driven capital projects. Yet, the ISS is just one of the several cases of science-driven capital projects organisations can leverage. Generally speaking, managers should 1) identify science-driven capital projects that are usually developed in the space, energy, defence, and digital sectors. Examples in the energy sector are the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME) [130] and ITER [21], intended to prove the viability of fusion as an energy source and to collect the data necessary for the design and subsequent operation of the first electricity-producing fusion power plant. Managers should also 2) reflect on the social value they intend to create. For example, in the development of

ITER, companies may contribute to the development of the research infrastructure, given their significant expertise in nuclear power plant development, or join as future users to develop new products and services based on nuclear fusion technology. 3) Managers should identify and mange the governance interfaces to join the governance of science-driven capital projects, by leveraging, for example, intermediaries such as universities. 4) Managers should scout for grants and contracts available and agreements already in place between public and private organisations, as shown for the space sector. Governments and public institutions are promoting the development of capital projects through their websites and portals, capital projects public initiatives can be found, for example, in Horizon Europe [131] and the U.S. Capital project Fund [132]. 5) Public institutions usually sponsor or co-finance the development of both "supplier" and "user" projects to foster the capital project they are developing. The private organisation should assess the funding availability to select the appropriate governance interfaces to join capital projects. European funding opportunities include the Cohesion Fund [133], LIFE [134], ERDF [135], ESIF [136], and RFCS [137]. By starting from the governance interfaces, managers should assess if and how the funding can support the company in joining the governance of capital projects and creating social value. The company should decide whether to enter the governance of the identified capital project to create social value under the availability of resources and capabilities. 6) If a company decides to enter the governance of a capital project, the social value created should be monitored over time and 7) properly reported aware of the different standards for social value claimancy.

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Biographies

Alessandro PARAVANO

School of Management, Politecnico di Milano, Via Lambruschini 4, 20156, Milano, Italy, alessandro.paravano@polimi.it
ORCID: https://orcid.org/0000-0002-6884-3712

Alessandro Paravano is a Post-doc at the School of Management at Politecnico di Milano, where he also works as a researcher in the Space Economy Observatory. He investigates the space industry value chain transition, its impacts on non-space sectors, and the value generated by space projects for the New Space ecosystem. His research has garnered grants from prestigious institutions, including the European Union Commission, the International Astronautical Federation, the Space Generation Advisory Council, the Project Management Institute, and the Italian Space Agency. He is a hourly-paid lecturer in the Executive Course in "Management for the New Space Economy" at PoliMi Graduate School of Business and a teaching assistant in the “Space Economy and Earth Observation Business” and "Complex Projects Lab" Management Engineering MSc courses. Graduated "Cum Laude" in Management Engineering at Politecnico di Milano.

Paolo TRUCCO

School of Management, Politecnico di Milano, Via Lambruschini 4, 20156, Milano, Italy, paolo.trucco@polimi.it
ORCID: https://orcid.org/0000-0002-0251-8538

Paolo Trucco is Full Professor of Industrial Risk Management and Deputy Academic Director of the School of Management at Politecnico di Milano. He is the Scientific Director of the Space Economy Observatory and member of the Steering Committee of the Centre for Technology Foresight at Politecnico di Milano.

He is technical advisor of DG Home Affairs (EC) on Critical Infrastructure Protection Policies, and collaborates with the ESA BASS on space commercialization; he is member of the Italian Copernicus Users Forum and advises the Italian Government on the National Space Economy Policies. He coordinates research collaborations with private companies of the space industry at international level.
He is founder and member of the Executive Board of CIRINT.NET (the Critical Infrastructure Resilience International Network).
Paolo’s primary research interests in the Space Economy domain are primarily related to Project Governance and PPPs, Technology Risk Governance, modularization and digitalization in space systems and supply chain, servitization and new business models. He has 25-years of professional experience in Risk Management and Resilience Engineering of complex socio-technical systems, in manufacturing supply chains, energy, transportation, and healthcare. He holds a MSc in Industrial Engineering and a PhD in Quality Engineering. He is author of more than 280 scientific publications.

Giorgio LOCATELLI

School of Management, Politecnico di Milano, Via Lambruschini 4, 20156, Milano, Italy, giorgio.locatelli@polimi.it
ORCID: https://orcid.org/0000-0001-9986-2249

Giorgio Locatelli is Professor at Politecnico di Milano at the School of Management, where he created and leads the major “Complex Projects Business” and Co-Editor-in-Chief of the Project Management Journal. He spent the years between 2012 and 2021 in the UK, starting as a lecturer at the University of Lincoln and leaving as a professor at the University of Leeds. Since 2006, Giorgio has researched large and complex infrastructure projects and programs. Giorgio is now also focusing on projects for sustainability transition and NetZero along with the “dark side” of projects, including corruption, modern slavery, discrimination, and unsustainability. Giorgio attracted over €1.7 million in research funds and is included in the Stanford-Elsevier list of the World’s top 2% of scientists. He acts as a trainer and advisor for public and private organisations. Giorgio has authored over 140 international peer-reviewed Scopus index publications with over 4000 citations. He is the winner of the 2023 “IPMA Global Research Award” winner. He also sits on the editorial boards of IPMJ, CME and PNE.

Appendix

Type of source	Frequency	Name of source and their frequency
News/Newspaper	54	Forbes (15); SpaceNews (13); BBC (9); CNBC (6); CNET (2); New York Times (2); Financial Times (2); Space.com (2); MIT News (1); Tech Crunch (1); Britannica (2); Statista (1).
Websites	89	NASA (41); ESA (11); Roscosmos (7); JAXA (3), CSA (2); SpaceX (3); Thales Group (3); Leonardo (1); Lockheed Martin (3); McKinsey (3); Axiom (1); Global Trade Funding (1); Northrop Grumman (1); Airbus (1); ASI (2); Morgan Stanley (1); The Planetary Society (1), Target (1), Goodyear (1), P&G (1), HPE (1)
Reports	49	NASA (12); OECD (6); SIA (6); Target (6), Goodyear (5), P&G (5), HPE (3); Globe News Wire (1); Space Foundation (1); UNOOSA (2); Global Market Estimates (1); ESPI (1).
Video Interviews	12	NASA (12)
Total	204	

Table 4 - Secondary data sources

#	Company Sector	Project developed	Job Role	Experience
Int 1	Space	In-Space project	Senior Vice President	21 years
Int 2	Space	In-Space project	President	25 years
Int 3	Space	In-Space project	Vice President	30 years
Int 4	ICT	On-Earth project	Vice President	39 years
Int 5	ICT	On-Earth project	Senior Vice President	34 years
Int 6	Energy	On-Earth project	Director, Investment and Economic Analysis	25 years
Int 7	ICT	In-Space project	Program Manager	20 years
Int 8	Industrial goods	On-Earth project	Chief Product Officer	35 years
Int 9	Industrial goods	On-Earth project	Senior Vice President	34 years
Int 10	Health	In-Space project	Sales Engineer	16 years
Int 11	Space	In-Space project	Chief Engineer	18 years
Int 12	Space	In-Space project	Director	20 years
Int 13	ICT	On-Earth project	Products & Services Executive	26 years
Int 14	Space	On-Earth project	CEO	25 years
Int 15	Health	On-Earth project	Head of Innovation	22 years
Int 16	Energy	On-Earth project	Director, Product Innovation	18 years
Int 17	Industrial goods	In-Space project	R&D Director	19 years
Int 18	Health	On-Earth project	Innovation Manager	10 years

Table 5 - Interviewee profiles

Key topic	#	Question
Profile	1	Interviewee profile Company profile Project description
Social value creation and claimancy	2	What is the social value created by the project you developed on the ISS?
	3	How did your organisation expect to leverage the social value created by the project? Why?
	4	How did your organisations contribute to the project the social value creation?
Joining the governance of capital projects	5	How did you join the governance of the ISS? Why?
	6	How did joining the governance of this research capital project enable you to create social value?
	7	How did joining the governance of this research capital project enable you to claim the social value created?

Table 6 - Interview protocol

Aggregate Dimension: **FAMILIARISE WITH CAPITAL PROJECTS AND SOCIAL VALUE**	
Second Order Codes	**Selected Evidence on First-Order Codes**
Identifying existing and future capital projects	*Scouting science-driven projects opportunities* "It is fundamental to scout and search for capital projects that are somehow related to our [their] business and could create social value aligned with the company's values and strategy" (Int 3) *Leveraging personal and organisational networks to understand the space sector* "We are an energy company, in theory, unrelated to space. Yet, some colleagues developed advanced solar panels based on technologies developed for outer space. Before experimenting on the ISS, the first thing I did was ask colleagues for support and their opinion" (Int 16). *Engaging with intermediaries to explore business opportunities* "Engaging intermediaries (such as universities and consultancy companies, is very important because they are able to explain you, in your language, what can be done and what can't be done" (Int 15),
Brainstorming on how your company could create social value by joining the governance of capital projects	*Involving internal expertise* "I built an internal working group with managers from several departments to brainstorm and discuss if developing projects on the ISS was aligned with our goals" (Int 2). *Benchmarking with competitors and peers* "We observed that one of our main competitors was developing and claiming the social value created by the vaccine-development experiment they developed on the ISS; it had strong media coverage and outreach. It was for sure an incentive to start projects on the ISS" (Int 15). *Assessing the value created with previous initiatives* "We are developing a platform, a digital marketplace. Non-space organisations may register to the portal, receive all the useful information and know our offer. There is also the possibility to contact us via the platform to start a conversation. It is open to all" (Int 4). *Clarifying your value proposition and its social value impact* "You have to clarify internally what you propose and what you want to achieve. We studied in depth the potential risks and opportunities in terms of social value creation to be sure the project development was effective and aligned with our values" (Int 14).
Aggregate Dimension: **JOIN THE GOVERNANCE OF CAPITAL PROJECTS**	
Second Order Codes	**Selected Evidence on First-Order Codes**
Identifying and managing the governance interfaces to join the governance of capital projects	*Engaging with institutions or operators of the science-driven capital project* "The point is that you have to engage institutions to understand what joining the governance implies, to understand the resources needed and the requirements to start projects on the ISS" (Int 1). *Asking for advice from intermediaries to understand the governance mechanisms* "Intermediaries are fundamental to manage the governance interfaces. They could facilitate the entrance in the governance, especially if you are not a space company" (Int 9). *Building competencies and capabilities to manage the governance interfaces* "Before joining the governance, you have to understand the capabilities needed and the competencies required. If they are not available, you have to build them. Otherwise, you can create social value" (Int 12)

Assessing public money availability	*Exploring public funding availability* "You have to understand were are the money to develop the project. You could participate in informative and networking sessions or engage with institutions or intermediaries. The point is that you must assess public money availability" (Int 17) *Clarifying the requirements to access public funding* "We carefully studied how to access NASA funding and the requirements because space is not our sector, and rules are completely different" (Int 4).
Starting due diligence	*Engaging with the capital project stakeholders* "You have to engage and negotiate, when possible, with the Space Agency as well as the companies supporting you in developing the project. It requires time and resources, but, even if it is not rocket science, it is fundamental to minimise future risks and costs, and maximise the expected social value creation" (Int 11). *Assessing the risks and opportunities* "If you are not a space company, assessing the risks and opportunities is challenging. Risks are very high and the benefits difficult to predict if you have not expertise in the sector, in this case, the assessment of risks mitigation strategies become vital" (Int 18). *Evaluating the expected social value creation* "To grasp the nuances of social value, it is necessary to involve all the key decision-makers in the organisation. Even if it may be challenging and time-consuming, it can't be only an exercise for the social responsibility manager or unit" (Int 2).
***Aggregate Dimension:* CREATING AND CLAIMING SOCIAL VALUE**	
Second Order Codes	**Selected Evidence on First-Order Codes**
Monitoring the social value created over time	*Developing metrics to assess the social value creation* "The social value must be measured. There are several standards and approaches. The importance is to base the reporting on existing ESG standards, adapted, if necessary, to the specificity of the project" (Int 12) *Controlling the value creation process* "Control the social value creation means having an active role in its creation. We engage periodically with the space agency and the ISS service providers to be sure the project outcomes align with the company's expectation" (Int 1). *Checking the alignment between the expected and actual social value creation* "The expected and social value should be aligned somehow. Joining the governance favour as the company developing the project has the right to implement corrective actions in case of misalignment" (Int 14).
Reporting transparently the social value created in your reports	*Communicating internally and externally the social value created* "You have to communicate internally the social value you create. There are several practices such as organising internal events to show the results, including the project description in the company's newsletter and asking for feedback from employees" (Int 10) *Leveraging professionals to report the social value created* "Reporting properly and transparently social value is not easy. You have to ask support from experts to claim the social value, so that the social value created and the role of the company can be properly described and understood by the stakeholders and society" Unt 7)

Table 7 - List of codes