1. Introduction

In recent years, the notion of science diplomacy has gained momentum among policy-makers and practitioners alike. Drawing on science and diplomacy as two distinct elements, it is commonly considered to be a distinct governmental response which strengthens "*the symbiosis between the interests and motivations of the scientific and foreign policy communities*" (The Royal Society & AAAS, 2010, p. vi). More specifically, science diplomacy is seen to be a manifestation of a new path of diplomacy which transcends national borders and draws on collaboration and exchange to keep communication channels open (Epping, 2020; Flink, 2020a; Flink & Schreiterer, 2010). This is particularly relevant in those cases where political and diplomatic ties are weak or, even worse, have reached a standstill between antagonistic countries (The Royal Society & AAAS, 2010). What is more, science diplomacy is seen as an instrument of soft power (cf. Almeida Domingues & Ribeiro Neto, 2017; Nye, 1990, 2008) that aims to convey a national image. More specifically, it is assumed to draw on scientific networks and distinct reputations to ultimately exert (political) influence and improve international relations. Therefore, science diplomacy is regarded as a promising new paradigm for public policy, potentially even a new approach to the governance of spaces (such as the Arctic, see Bertelsen, 2018). These assumptions mirror the richness of themes and suppositions which are tied to the prevailing science diplomacy discourse. While science diplomacy has great potential as a vehicle for facilitating and improving international relations (although expectations may be somewhat over-optimistic), the contemporary debate on science diplomacy remains largely hypothetical and the concept is often used in an ambiguous way, mostly inspired by normative considerations.

In response, this study aims for a more tailor-made approach and positions science diplomacy as a distinct governmental response to international dynamics of cooperation and competition (Flink & Schreiterer, 2010; Ruffini, 2020a; Schütte, 2008), which are characteristic of the knowledge society (Välimaa & Hoffman, 2008). To explicate, governments find themselves increasingly exposed to and situated in these dynamics, while even system competition is assumed (Kuhlmann, 2008; Schütte, 2008). Given that natural resources are scarce, countries seek to secure their competitive

advantage and partake in international markets in the global knowledge economy (Zapp, 2022) and need to formulate responses to these goals (Chou & Ulnicane, 2015). These responses arguably also include science diplomacy. Pursuing this further, scholarly literature highlights the relevance of science, technology and innovation in securing societal growth and tackling broad societal challenges (Boon & Edler, 2018; Kuhlmann & Rip, 2018). What is more, knowledge (and its forms of production) are becoming increasingly international. This is because the topics themselves are increasingly global in nature (such as "*grand challenges*" (Keenan et al., 2012)), but shrinking spaces are also being encountered. More specifically an increased interconnectedness and interdependence can be observed among countries given their specialised knowledge or distinct research infrastructures.

Moreover, it is argued that science is becoming more and more global (Kwiek, 2021) and denationalisation of science is being encountered (Crawford, Shinn, & Sörlin, 1993). In a similar vein, the importance of science, also for other domains, has been highlighted (Drori, Meyer, Ramirez, & Schofer, 2002) in the sense that scholars argue for (an ongoing) scientific revolution and a race for knowledge (Schütte, 2008): for the "*century of science*" (J. J. W. Powell, Baker, & Fernandez, 2017). Expressions of this are seen, for instance, in increasingly internationalised environments in higher education and research domains (Huisman & van der Wende, 2005; van den Besselaar, Hemlin, & van der Weijden, 2012) but also in intensified international research collaborations (Ulnicane, 2021; Wagner & Leydesdorff, 2005), which aim for scholarly exchange and to produce new knowledge (Dusdal & Powell, 2021; J. J. W. Powell, 2018; Wuchty, Jones, & Uzzi, 2007) or international mobility patterns.

In line with these developments, governments are increasingly concerned with securing their positions in the competitive market and deploying different strategies to that end. Among the more specific responses to this are instruments which are intended to work within the system, such as research excellence policies (Cremonini, Horlings, & Hessels, 2018), while internationalisation is also being promoted as a way of attracting talent (Lepori, Seeber, & Bonaccorsi, 2015) or of entering new (emerging) markets. Science diplomacy can be situated as a governmental response alongside these forms of logic (Epping, 2020; Flink & Schreiterer, 2010; Ruffini, 2020a) as a way of creating capacity for the national (science) system, securing talent or gaining access to (emerging) markets. More specifically, it is seen as a way of promoting national branding and reputation which

aims to differentiate countries from other direct competitors in the global market (Flink & Schreiterer, 2010).

While science diplomacy can be positioned as a distinct governmental response to the dynamics of cooperation and competition, this has been studied to a lesser degree: science diplomacy scholarship is still in its infancy, and there is also a lack of empirical insights to supplement core claims or ways of working, which was pointed out at the beginning of this chapter (Epping, 2020; Ruffini, 2020b). This opens up distinct windows for research because for scholarly literature it seems to be most pressing to understand this phenomenon in more specific ways and beyond normative claims. To illustrate this, if science diplomacy is seen as a governmental response, it is relevant to generate an insight into how this translates into practice. More specifically, this links to several questions: What kind of distinct policy instruments are applied to that end? Moreover, do they advance scholarly understanding of specific tools which also aim to promote cooperation and competition? In which ways do they differ? What is more, given the normative claims which characterise the use of science diplomacy, it is relevant to identify the underlying new governance arrangements which are in place. More specifically, the analysis of science diplomacy might reveal an insight into new strategies that countries can adopt regarding their international positioning and also show if and how they deploy science to that end (in line with its core assumptions). These questions clearly advance scholarly understanding of governmental responses to competition and collaboration. In addition, they contribute to the conceptual understanding of the study of science diplomacy. The next section discusses the research focus and puts forward the leading questions.

1.1. Research Focus

This thesis[1] contributes to the body of knowledge on science diplomacy, which has to a large degree been identified as normatively coloured (Ruffini, 2020b; Rungius & Flink, 2020). To overcome this shortcoming and, nevertheless, find a meaningful way to analyse science diplomacy, this study adopts an instrument-centred perspective, which makes it possible to translate specific findings from case study analysis to the wider discourse

1 This thesis draws to a large extent on an earlier study by the author, see Epping (2020).

of science diplomacy and the dynamics of cooperation and competition. So far, scholarship has largely neglected to analyse the instruments of science diplomacy and their ways of working, which is notable given that policy instruments are (traditionally) viewed as techniques to implement governmental objectives (Howlett, 1991) and essential elements of public policy (Linder & Peters, 1989, p. 43). This thesis responds to this knowledge gap and analyses Science and Innovation Centres (SICs) in more detail. SICs constitute a distinct and underexplored institutional response in the governmental toolbox; however, they are increasingly being adopted by highly innovative countries[2]. In essence, this work aims to gain an insight into why countries are increasingly adopting SICs as well as why and how organisational actors use these instruments. More specifically, this refers to key organisational stakeholders rather than individuals. Drawing on earlier contributions, this study defines a SIC as follows:

> *distinct unit or satellite institute which has been established in another country by a government and which operates at the nexus of higher education, research, innovation and diplomacy.* SICs have further been characterised as operating within a network structure (cf. Epping, 2018, 2020).

Rather than taking a snapshot of an instrument, this thesis aims to conduct a longitudinal analysis to understand SICs from their emergence and their development over time, and to ultimately allow for a detailed, contextualised explanation of the current shape of SICs. This approach constitutes an advancement to present scholarship. A longitudinal analysis is seen to be beneficial as scholarly literature refers to a re-labelling of certain practices, which are not new in their essence, in favour of science diplomacy (Epping, 2020; Flink, 2020b; Ruffini, 2020a). In addition to understanding how SICs developed historically, a complementary element of this study aims to identify the perceived added value and the use of the instrument by key actors[3]. In other words, this work probes why actors participate in SICs, unpacking their differing rationales, which develops a distinctively

2 The Global Innovation Index (WIPO (2021)) ranks highly innovative countries. This ranking facilitates our understanding of innovative countries.

3 Please note, in this study the focus is not on individual actors but rather on organisations which participate in SICs.

actor-centred perspective on science diplomacy. These objectives translate into the following key research question:

> *How can the development and the institutionalisation of SICs as distinct policy instruments of science diplomacy be explained?*

This question can be divided into four sub-questions which help to answer the main question:

(1) What are SICs and how can they be characterised?
(2) Why did SICs emerge and how have they developed since their genesis? How can the current model be explained?
(3) Which actor groups are involved in SICs and what explains their participation?
(4) How can the study of SICs be used to further understand and advance the concept of science diplomacy?

Therefore, this study positions itself in such a way that it generates an insight into SICs and more generally into the rising field of science diplomacy. The findings of this study allow us to further understand and advance the normatively coloured concept of science diplomacy by drawing on novel empirical insights, which have the potential to structure ongoing debates in more rigorously grounded and policy relevant terms. In addition, the findings shed light on a distinctly actor-centred perspective of science diplomacy and its governance. The design that this thesis applies is outlined in the next section.

1.2. Research Design

In light of the growing momentum of science diplomacy (also due to recent geopolitical events) and evidence of a (growing) isomorphic trend towards establishing SICs among highly innovative countries, this work is set up in an inductive and exploratory way. The analysis follows four distinct steps in order to investigate the overall research question: a) characterise SICs and propose a typology-building exercise, b) examine the (gradual and historical) institutionalisation of SICs, c) analyse stakeholders' use of SICs and d) contribute to the scholarship on science diplomacy. These steps are outlined in more detail in the following.

Firstly, characterisation of SICs according to their organisational set-up and method of operation is provided, which has so far constituted a gap

in scholarly literature. More specifically, a typology is developed which identifies three types of SICs and characterises them in an ideal-typical way to underline their distinctness: a) *the representational model*, which has an irreducible bureaucratic core and a way of operating that is largely determined by key stakeholders, b) *the service-oriented model,* which offers services and caters to the needs of stakeholders on an ad hoc contractual basis and also responds to market developments, c) *the policy-led model*, which is closely tied to political goals and primarily responds to these (political) needs. In fact, policy-led models are an integral part of a country's diplomatic representation and presumably operate within this (bureaucratic) framework. This typology structures the SIC landscape and serves as an entry point for further research. Furthermore, this thesis conducts an in-depth comparison of two SICs in their national contexts. The representational model and the service-oriented model have been selected for comparison. The German *Deutsche Wissenschafts- und Innovationshäuser* (DWIH) exemplifies the representational model and Switzerland's Swissnex embodies the service-oriented model. Both models constitute distinct cases in the SIC universe and provide an insight into the governance of science diplomacy and potentially reveal distinctly new structures. Studying a representational model and a service-oriented model enables a high level of innovation in the findings due to the network-based structures of these SIC types and their stronger detachment from political goals in comparison to the policy-led model. What is more, both SICs have established distinct organisational units, which largely operate outside the diplomatic umbrella (thus, they are less hierarchically organised) and are hybrid concepts in terms of their actors, themes and set-up. Therefore, studying these two cases can be expected to reveal a higher degree of institutional innovation. This ultimately generates novel insights into the governance of science diplomacy and enables unique patterns of interactions to be identified.

Secondly, these two case studies are subject to closer analysis. This thesis deploys a two-step heuristic framework based on the theoretical considerations of Lascoumes and Le Galès (2007), which helps to explain how SICs developed and institutionalised. This framework works as a structure for the empirical analysis and specifies the analytical path of this study. More specifically, a conceptual framework is modelled which traces the trajectory of the instruments, i.e., their careers over time within their national contexts (Lascoumes & Le Galès, 2004, 2007). This approach advances present scholarship because of its long-term and detailed approach. Specific aspects which deserve attention include contextual factors, the actors

involved, the discourses that accompanied the instruments' design and launch, and events which impacted the instruments' subsequent development (Lascoumes & Le Galès, 2007). The work of Lascoumes & Le Galès can be situated in the wider literature on policy instruments, while it also adopts a distinct understanding of policy instruments as institutions in a sociological sense. Specific implications derive from this understanding in the sense that instruments are defined as being carriers of meanings and norms which structure interactions and have the potential to reinforce institutionalisation dynamics. Moreover, the authors argue that instruments might develop a life of their own which differs from what was initially politically anticipated (Kassim & Le Galès, 2010). A strategy to account for this is the analysis of the long-term career of instruments. Hence, this framework can capture changing notions of science diplomacy as manifested in SICs and is able to evaluate whether re-labelling occurs. A complementary component of the framework argues for focusing on the use and interpretation of the instrument by key actors since their use of it is seen to reinforce institutionalisation dynamics and create distinct effects. In other words, the use of the instrument by key actors might create distinct (instrumentation) effects which might, in turn, promote institutionalisation dynamics (Lascoumes & Simard, 2011). This thesis hence contributes to scholarly literature on institutionalisation processes of (organisational) instruments.

Accordingly, as a third step, this study develops a distinctly actor-centred perspective on science diplomacy and analyses the way that SICs are used by their key actors. This helps to shed light on their interpretation of SICs and makes it possible to identify distinct effects and institutionalisation dynamics which might have impacted the development of the two instruments. To provide an understanding of how and why actors might use these instruments, this study mobilises the work of Ahrne and Brunsson (2005, 2008) on meta-organisations to the extent that it conceptualises considerations which explain why actors (i.e., organisations) agree to participate in collective action. Since SICs aim to foster collective action, these considerations constitute a meaningful entry point (leaving aside the question of whether SICs are themselves meta-organisations, which is not germane for the present study).

In the fourth step, the findings of these sections are merged to reflect on scholarship regarding science diplomacy. The study's instrument-centred approach enables the transfer of these key findings to the wider discourse

and illuminates the governance of science diplomacy (actors, rationales and instruments) while developing a distinctly actor-centred perspective.

This study is set up in an inductive way to account for the novelty of the phenomenon. It draws on a combination of qualitative data sources (interviews and documents) to answer the main research question and create a rich and comprehensive data set, which informs the analysis. Expert interviews (Bogner & Menz, 2001), which gave scope to narrative elements (Bevir, 2006; Helfferich, 2011), inform this study, while documents (Bowen, 2009) are also used as a key source. These two sources facilitate tracing the instruments' development and provide an insight into stakeholders' rationales behind using SICs in an unprecedented way. The long-term focus and the nuanced analysis which will be provided in this study advance scholarship in this field, in particular the governance of science diplomacy. The use of these two data sources allows for triangulation (Flick, 2011) and is seen as a meaningful strategy to compensate for each other's limitations such as the availability of and access to data. The next section presents the thesis' structure.

1.3. Research Structure

In line with the research objective of explaining the development and the institutionalisation of SICs, as distinct instruments of science diplomacy, this study is structured as follows:

Chapter 2 provides an introduction to science diplomacy, the key topic of this study. Scholarly literature is critically reviewed to establish an in-depth understanding of the concept and to reveal how it is analytically framed. An attempt is made to define science diplomacy and identify the key assumptions that guide the concept. Furthermore, this chapter critically reflects on the prevailing use of science diplomacy as a concept. The discourse is characterised by weak empirical insights and normative colouring, which ultimately weaken the meaningfulness of the concept. In light of these shortcomings, a meaningful way to analyse science diplomacy is selected by focusing on a practical example, i.e., a selected instrument.

Chapter 3 introduces Science and Innovation Centres (SICs), the instrument which is central to this work. SICs are a distinct and novel policy instrument and are among the few institutional responses in the science diplomacy toolbox. Whilst SICs are notable and unique instruments, they are largely neglected in academic scholarship. A solid definition of SICs

is provided and is underpinned by a systematic comparison of SICs. Furthermore, an attempt is made to structure the observed empirical data by proposing a SIC typology. Three SIC models are classified in order to facilitate the analysis and study of this novel institutional development: service-oriented SICs, representational SICs and policy-led SICs. In the course of this study, two of these models (the service-oriented SIC and the representational SIC) are analysed in depth to provide a scholarly assessment of this novel instrument since the level of institutional innovation expected to be revealed by studying these models is considered to be higher.

Chapter 4 puts forward the conceptual framework, which facilitates the instrument-centred approach to the analysis of science diplomacy. The chapter develops the generic notions and key characteristics of policy instruments and specifically adopts an understanding of instruments as institutions in a sociological sense (Lascoumes & Le Galès, 2007). This understanding suggests a distinct analytical approach and provides a two-step heuristic framework: firstly, an analysis of the trajectory of the instruments i.e., their careers over time; secondly, the use of the instrument by key actors and the distinct effects, known as instrumentation effects, this creates. These effects consolidate and institutionalise the instruments and hence provide a valuable way of understanding the development and institutionalisation of SICs as distinct science diplomacy instruments. This conceptual framework mobilises the theoretical considerations of meta-organisations in a selective way to facilitate the development of a distinctly actor-centred perspective (leaving aside the question of whether SICs are themselves meta-organisations, which is not germane for this study).

Chapter 5 specifies the methodological choices that are made. Due to the comparatively weak empirical basis and normative colouring of much previous work, this study follows inductive and exploratory logic, which allows for the detailed comparative analysis of two meaningful SICs in more detail (a service-oriented SIC and a representational SIC). Interviews and documents serve as the main sources that generate evidence.

Chapters 6–11 present the two case studies. *Chapters 6–8* describe the results and insights into the representational SIC (German case study: DWIH). First, the DWIH network is introduced, which is followed by an analysis of the DWIH's trajectory and its appropriation by key actors. *Chapters 9–11* provide the empirical material for the service-oriented SIC (the Swiss case study: Swissnex). First, Swissnex is introduced, followed by an analysis of its trajectory and its appropriation by key actors.

Chapter 12 merges the empirical cases and provides a comparative analysis in line with the conceptual architecture that guides this study. The comparative analysis reveals key factors which explain the development of SICs in their respective settings and their current forms. In addition, the appropriation of the SICs by their key actors is discussed comparatively. This sheds light on the aspect of instrumentation, which has also been identified as critical in explaining the shape of SICs.

Finally, *Chapter 13* presents the overall conclusions of the study. It completes the circle of the instrument-centred approach by applying the key findings of this study to the wider science diplomacy discourse. Drawing on the findings of this study, conceptual refinements to the notions of science diplomacy are suggested. Most prominently, it is argued that science diplomacy must be understood in its national context, as this explains the shape that science diplomacy instruments may take or the actors which can be classified as actors of science diplomacy. Furthermore, this chapter summarises this study's contributions to scholarly literature and identifies the limitations that were encountered. Finally, suggestions are made regarding distinct avenues for further research to advance the science diplomacy discourse and the body of knowledge on SICs.