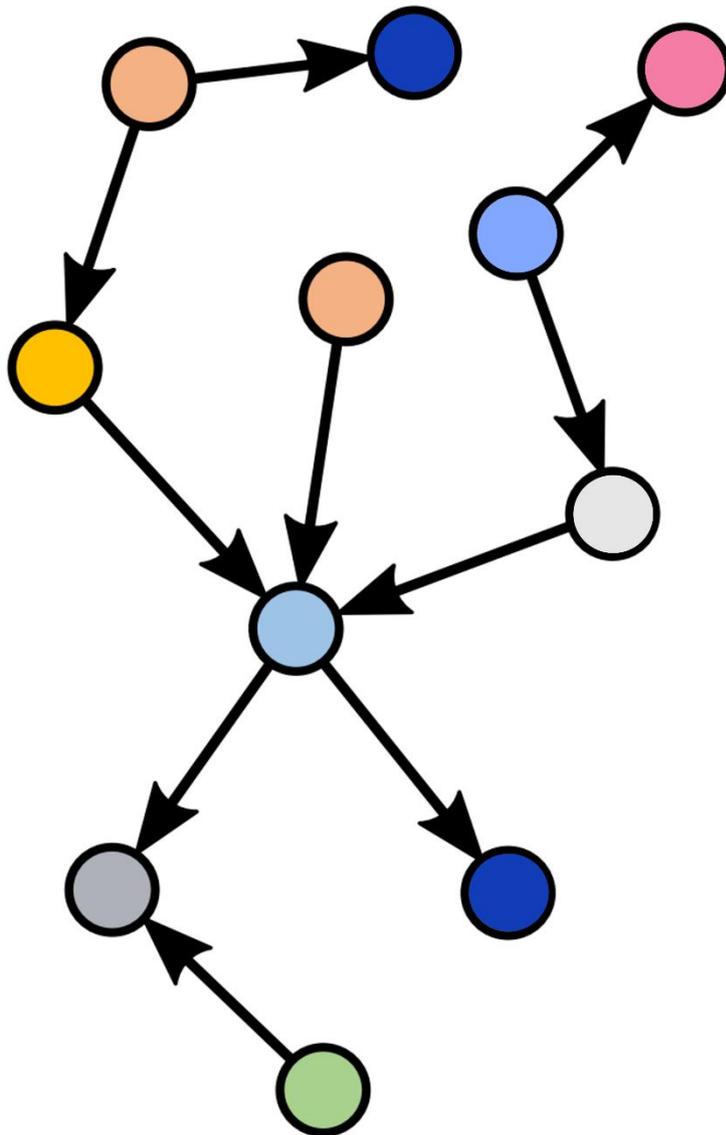


# Getting a grip on control points

An exploration of literature



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## An exploration of literature

Author(s)	Daan Pisa, Joris Vierhout, Amber Geurts, Thijmen van Bree
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# Management summary

As a result of growing geopolitical tensions, increasing international dependencies, societal challenges, and the emergence of new, potentially disruptive technologies and value chains, the Dutch innovation landscape has embraced the concept of “control points”. Focused on acquiring leading positions in emerging value chains, the term is increasingly being adopted within industry and innovation policy. In order to offer an actionable perspective on the new questions this give rise to, this literature study includes an initial exploration of the concept. This exploration provides context and direction for acquiring, strengthening, and maintaining control points in the Netherlands.

Although the focus on control points seems to be a recent development, the term has already been applied in contexts such as strategic management. More recent is the thinking about control points in the context of value chains, business models and ecosystems, and technological sovereignty and strategic autonomy. Based on a literature review, we introduce three complementary and overlapping perspectives on control points: 1) the micro business perspective, 2) the meso network perspective, and 3) the macro geopolitical and geoeconomic perspective.

## **Business perspective**

From a business perspective, the focus is on strategies that enable individual firms to gain a competitive advantage. Within this context, a control point can be defined as a unique and (economically) valuable business activity that is difficult to imitate and replace. Under this definition, a business activity is unique when there are few or no other parties offering the distinct value proposition. The threat of new entrants and substitute goods is also relatively low. Acquiring control points also depends on possessing and being able to utilize (a combination of) strategic resources and capabilities. However, control points cannot be created entirely in advance; creating them in a targeted manner involves a high degree of uncertainty.

## **Network perspective**

The network perspective on control points examines the influences and dependencies within networks such as markets, value chains, and ecosystems. A control point is considered here to be a unique and influential business activity on which other parties in the network are heavily dependent. This position of power depends in part on the uniqueness of the business activity and the number of competitors offering alternatives. The business activity creates dependency by influencing the activities and earning capacity of other parties, for example through pricing and/or value chain governance. Suppliers and/or customers are highly dependent on a control point. In addition, both suppliers and end producers can own control points. Barriers to entry can then ensure that a control point consolidates and is maintained.

## **Geopolitical and geoeconomic perspective**

The geopolitical and geoeconomic perspective on control points focuses on strategic dependencies and the societal role of innovative capacity. From this perspective, a control point is defined as a (concentrated network of one or more) business activity(ies) on which the innovative capacity and public functions of states are heavily dependent. Within this perspective, a control point can therefore also refer to a network of business activities. Innovative capacity is seen here as the ability to develop, produce, and offer technologies.

The public functions of states in this regard concern guaranteeing national security, promoting economic earning power and competitiveness, and providing for broader societal needs. Substantial influence, or strong dependence, exists when these activities are unique and their loss leads to a lack of capacity to innovate, create value, and/or fulfill public functions.

### **Opportunities and vulnerabilities**

Control points fulfill various roles and influence public interests such as economic earning capacity, national security, and other aspects of broad prosperity. Control points create both opportunities and vulnerabilities that justify interventions based on industrial and innovation policy, with broad prosperity as the starting point.

While control points drive investment power, innovation, and future earning capacity on the one hand, they can also hinder efficient market and system functioning on the other. The economic benefits offered by the strong geographical spread of chain activities also create, to a certain extent, an inevitable dependence on foreign control points. At the same time, existing control points can create dependencies that hinder the achievement of transformative goals and potentially new control points. In order to stimulate future earning capacity with the emergence of new technologies and market dynamics, it is therefore important for governments to both strategically build new control points and dismantle obstructive control points. By reducing existing dependencies or creating more reciprocity by investing in new control points, the government can continue to safeguard public interests.

### **Conclusion and follow-up research**

Although thinking in terms of control points is not new, the concept has taken on a different meaning in recent years: the classic perspective on control points focused on individual firms with a competitive advantage has been replaced by a perspective on control points in the context of value chains and ecosystems, which examines the influences and dependencies within networks. In light of recent geopolitical and geoeconomic developments, an additional perspective has been introduced, which addresses strategic dependencies and the innovative capacity and public functions of states (i.e., safeguarding national security, promoting economic earning power and competitiveness, and meeting broader societal needs). The latter perspective is conceptually and normatively novel.

To stimulate earning capacity and R&D within a geopolitically uncertain context, innovation policy should focus on control points. On the one hand, this involves focusing on building and strengthening one's own (future) control points, and on the other hand, it involves dismantling control points in order to gain control over existing dependencies. The network perspective and the geopolitical perspective in particular provide scope for new forms of innovation policy in light of control points. In addition, promoting control points also contributes directly to the goal of the Netherlands spending 3% of its GDP on public and private R&D investments by 2030, because firms with a control point are often characterized by high R&D expenditures. The three perspectives provide different tools for intensifying R&D by building control points in the Netherlands and reducing dependencies.

In addition, consideration can be given to how to strategically focus on new value chains and innovations that drive transitions, building on the activities in which the Netherlands already specializes. The National Technology Strategy (NTS), National Growth Fund Programs, and the Netherlands' growth market strategy offer concrete points of contact with the establishment of control points for the future. Finally, the new government program endorses the importance of economic resilience and security. Based on public interests that extend beyond economic earning capacity, risky dependencies on foreign control points can be

reduced by building up control points within chains. Finally, risky dependencies can be proactively reduced through additional (European) policies aimed at, for example, tighter market regulation, strategic innovations for substitution, or import and export levies.

Creating and dismantling control points, and designing concrete policy interventions to facilitate this, requires strategic insight into which current (value chain) activities are undesirable or risky, on the one hand, and into which value chain components the Netherlands can realize unique business activities based on its specialism, on the other. Further research is therefore needed to put the concept of control points into practice. Current control points in the Netherlands and abroad must be identified, as must the opportunities and vulnerabilities of possible future control points.

This requires an appropriate and substantiated evidence base for identifying control points that can be used to legitimize policy interventions and design specific policies targeting the designated control points. A solid evidence base builds on both traditional innovation metrics – such as patents, publications, or economic activity – and a mix of potentially new indicators, such as links between technologies, the knowledge or business strengths of other countries, or dependence on raw materials. In addition, qualitative insights can also be used, such as the complexity of value chains and the relationship with innovation ecosystems. Such qualitative insights can answer the question of which assets, competencies, governance, or activities are important for supporting firms and ecosystems that strive for control points, and which policy instruments can be used to achieve such control points.

This follow-up study thus provides insight and a perspective for action for innovation policy at control points. This enables R&D and innovation policy that is not only geared toward (future) earning capacity, but also toward control points. As a result, R&D and innovation policy can focus in a substantiated manner on the Netherlands' greatest opportunities and vulnerabilities in a geopolitically uncertain context.

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# 1 Introduction

This literature review aims to provide strategic insight into control points in the context of firms, networks, and open strategic autonomy. To this end, this study will embed the concept in the (academic) literature in order to arrive at specific definitions of it. In addition, this literature review aims to offer perspective for policy interventions aimed at building and dismantling control points.

## **Control points as a strategic focus on innovation**

The autonomy and sovereignty of both the Netherlands and Europe are under pressure. This is due, among other things, to growing geopolitical tensions, international dependencies, and the emergence of new, potentially disruptive technologies and value chains. Focusing on a completely self-sufficient economy is unrealistic and unachievable. After all, an open economy brings great prosperity and progress. It is therefore increasingly recognized that we must instead strategically focus on the knowledge, (key) technologies, and value chains in which we as a country are unique and relatively strong. This allows us to distinguish ourselves from, for example, the United States and China, and create mutual dependence. In addition, a strategic focus on innovation provides direction and new opportunities to tackle social challenges such as climate change and aging populations.

In order to respond proactively to this, the Dutch innovation landscape has embraced the term 'control point'. Partly inspired by the position and success of a firm such as ASML, other parties have also started to focus on acquiring new, leading positions in emerging value chains. The NXTGEN Hightech Growth Fund program, for example, explicitly focuses on acquiring control points in domains such as agrifood, biomedical, and laser satellite communication. Meanwhile, the term is increasingly being adopted within the (high-tech) industry and innovation policy. This raises new questions, such as how control points can be defined, how they arise, how they relate to private and public interests, and what opportunities and/or vulnerabilities such control points can create. In order to offer an actionable perspective, this literature study includes an initial exploration of the concept. These insights provide context and direction for creating and dismantling control points in the Netherlands.

## **Structure of the report**

This report is structured as follows. Chapter 2 discusses the origin of the concept of 'control point' and the contexts in which it can be applied. Based on this, three perspectives on control points are introduced: the business perspective, the network perspective, and the geopolitical and geoeconomic perspective. Chapters 3, 4, and 5 describe these perspectives by briefly discussing relevant literature and deriving the perspectives from it. Chapter 6 then discusses the influence of control points on public interests and the opportunities and vulnerabilities that legitimize policy interventions. Finally, Chapter 7 offers the conclusion to this literature review, including starting points for innovation policy and opportunities for further research.

## 2 Origin and application of control points

The focus on control points within an economic context appears to be a recent development. However, the rationale behind it is not new, and the use of the term also appears to date back further. Since the 1980s, strategic (innovation) management literature has focused on the central question of how a firm can acquire a strategic position that gives it a competitive advantage over its competitors (Porter, 1985; Barney, 1991). Strategic control points (cf. Slywotzky & Morrison, 1997) would enable a firm to secure competitive advantage and profitability through certain organizational characteristics or levers. Examples of such firm-specific strategic control points include owning the industry standard, patents, a strong brand, or customer relationships (Slywotzky & Morrison, 1997).

More recent is the thinking about control points in the context of (digital) communication value chains, business models, and ecosystems.<sup>1</sup> Compared to Slywotzky and Morrison's definition, a control point is not only considered a characteristic of a firm, but also emphasizes the influential position of a firm in a value chain or ecosystem, which allows a firm to exert influence on other actors. Control points thus refer to positions within networks from which firms can exert influence on other actors. In the Netherlands, the NXTGEN Hightech Growth Fund program builds on this approach and defines a control point as "strategic business activities through which a firm claims a unique position in the value chain."<sup>2</sup>

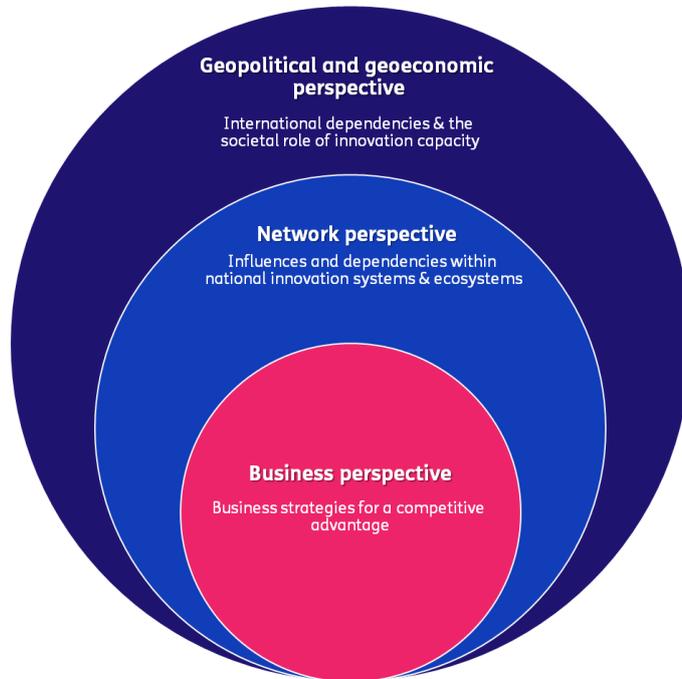
In recent years, we have become increasingly aware of the growing globalization of innovation and the emergence of complex international value chains and ecosystems that introduce interdependencies (Gerrefi et al., 2005; Wagner & Bode, 2008). As a result, few innovations and/or technologies are now developed, produced, and used within the borders of a single country. In the current geopolitical climate, there is therefore a growing policy debate about technological sovereignty (Edler et al., 2023) and open strategic autonomy (TNO, 2024a; Damen, 2022). As a result, we are also seeing the emergence of a geopolitical and geoeconomic perspective on so-called control points, which focuses in particular on strengthening the role in international innovation ecosystems in order to acquire 'a position of control' (cf. Kroll & Frietsch, 2022).

In order to further develop the body of thought regarding control points, this report aims to provide an initial assessment for the theoretical embedding of control points in the literature. We will discuss the three complementary and overlapping perspectives on control points that we have identified in the literature. These perspectives are: 1) the micro business perspective, 2) the meso network perspective, and 3) the macro geopolitical and geoeconomic perspective (see Figure 2.1). The literature review is a preliminary inventory that briefly discusses the theories and concepts with a strong evident conceptual link and is

<sup>1</sup> See for instance Trossen & Fine (2005), Eaton et al. (2010), Pagani (2013) en Bohnsack et al. (2024).

<sup>2</sup> See <https://nxtgenhightech.nl/en/content/market-oriented-development-activities/control-point-workshops/>

therefore not exhaustive. This theoretical deepening serves to arrive at precise definitions of control points, so that context and direction can be provided for acquiring, strengthening, and maintaining control points in the Netherlands. Control points create both opportunities and vulnerabilities for economic earning capacity, national security, and broad prosperity, which legitimize interventions from industry and innovation policy.



**Figure 2.1:** Three perspectives on control points

## 3 Business perspective

Within the micro or business perspective on control points, the focus is on the strategies and performance of individual firms with regard to creating a competitive advantage; the situation in which a firm or organization performs substantially better and creates more value than its competitors (Porter, 1985; Barney, 1991). For example, through economies of scale and an extensive distribution network, IKEA enjoys a competitive advantage in offering furniture products at low prices. In addition, by developing reusable rocket technology, SpaceX has been able to reduce launch costs, which also gives them a competitive advantage in the space industry.

This perspective can be strongly linked to strategic management literature, in which creating a competitive advantage is a primary focus. The central question that strategic management has been addressing since the 1980s is therefore how organizations can achieve or maintain such a competitive advantage. Different but complementary views and concepts within strategic management attempt to provide an answer to this question. These perspectives and concepts are first summarized in this chapter and then linked to control points in the discussion.

### 3.1 Market-based view

In the first, market-based view, external market conditions and firms' strategies in response to them are considered the decisive factors that explain firms' competitiveness and profitability. A leading framework within this perspective is Michael Porter's five forces model (Porter, 1979). According to Porter, the presence and dynamics of five factors (see Figure 3.1) influence the 'attractiveness' of the market in which a firm can gain a competitive advantage over other firms (Porter, 1985).

The first factor concerns the *intensity of competition* between existing players in the market. If competition is fierce, firms may be forced to lower prices, which affects their profitability. The second and third factors concern the *power of suppliers* and *the power of buyers*. This revolves around the extent to which these parties can influence prices, products, and conditions in the market. For example, if a firm's suppliers are highly specialized or its customers are highly concentrated, they have relatively more bargaining power, which affects the firm's profitability. The fourth and fifth factors describe the *threat of new entrants* and *substitute goods*. These refer respectively to the extent to which new firms can enter the market and compete with established firms, and to the availability of alternative products or services that can meet the same demand within the market.

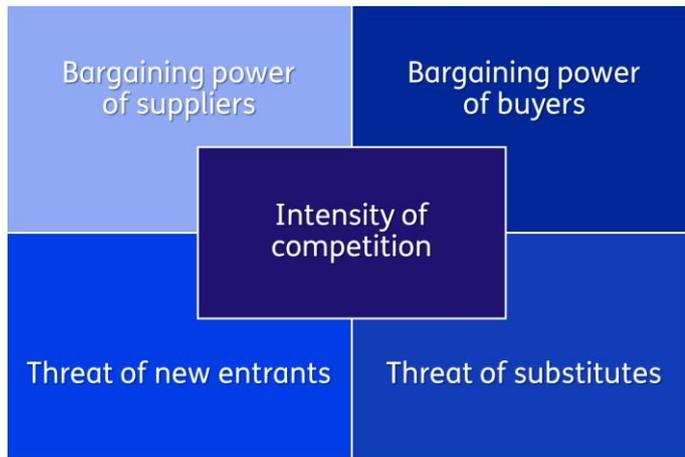


Figure 3.1: Five Forces model of Porter (1979)

Porter (1980) argues that firms can develop strategies to gain a competitive advantage by analyzing these five factors. Porter distinguishes between four generic strategies (see Figure 3.2).

The first strategy is *cost leadership*, whereby firms strive to have the lowest costs within their market. By maximizing efficiency and minimizing costs, they can offer their products or services at lower prices than their competitors, giving them a competitive advantage. This is particularly effective in markets where customers are price-sensitive or where there is a threat of new entrants. Second, firms can pursue *differentiation*, offering unique products or services that are valued by customers and difficult for competitors to replicate. By delivering superior quality, design, service, or other features, they can attract more loyal customers and reduce price pressure. This strategy is attractive, for example, in markets where customers are willing to pay more for unique features and where the threat of substitutes is high. Finally, firms can focus on a *specific segment or niche* within their market. By concentrating on the needs of a specific customer segment, they can better meet the unique requirements of those customers and avoid competition with broader segments. Within this niche market, firms can again pursue cost leadership and differentiation.

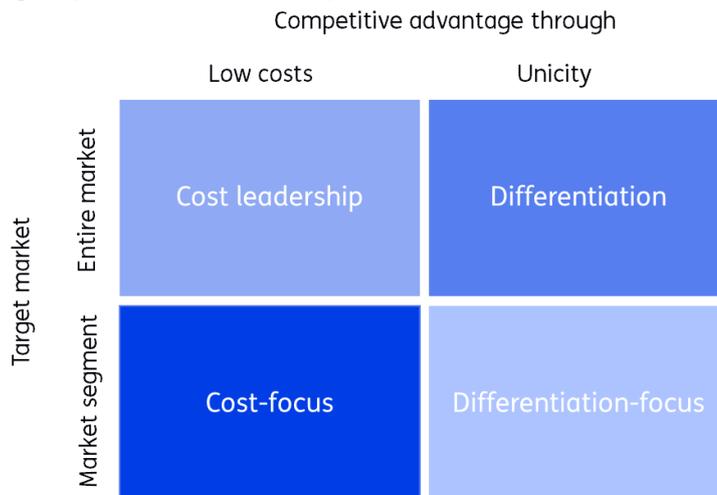


Figure 3.2: Generic strategies for a competitive advantage, based on Porter (1980)

## 3.2 Resource-based view

While the market-based view offers insights into the circumstances and strategies that enable firms to gain a competitive advantage, it does not explain why some firms succeed and others fail. This limitation gave rise to the second perspective on competitive advantage. This resource-based view assumes that firms are heterogeneous in terms of the **resources** they have at their disposal and that it is precisely these resources (or combination of resources) that determine whether they achieve a competitive advantage (Barney, 1991). Resources are interpreted quite broadly here, namely as all assets, skills, processes, characteristics, knowledge, and information of an organization that contribute to its competitive ability. Four characteristics described in Barney's (1995) VRIO model (Valuable, Rare, Imitable, Organization) must be met:

- › The resource is **valuable** and enables an organization to function more effectively and/or efficiently by exploiting opportunities or mitigating risks;
- › The resource is **unique** and does not exist in (many) other organizations;
- › The resource is **difficult** for other organizations **to imitate and replace**;
- › The **organizational structure and culture** enable the resource to be exploited.

Barney argues that there are three reasons why resources can be difficult to imitate. First, unique historical events and experiences – or path dependencies – can enable firms to obtain or exploit certain resources. Second, causal ambiguity can play a role; this is the situation in which it is not fully known to either the firm or others how a resource contributes to competitive advantage. Finally, resources can be socially complex (e.g., relationships, culture, reputation) and therefore beyond the reach of firms to control.

## 3.3 Dynamic capabilities-based view

In addition to the above explanations, Teece et al. (1997) introduced a third perspective in the late 1990s. Unlike previous perspectives, this dynamic capabilities-based view does not focus solely on achieving a competitive advantage. Instead, it focuses primarily on how such a competitive advantage can then be maintained, particularly in markets that are subject to rapid change. This perspective assumes that, of all an organization's resources, **dynamic capabilities**, or adaptive competencies play an essential role in this. This specifically involves the ability to continuously recognize new developments, opportunities, and threats (including technological, economic, and geopolitical) and to then anticipate and act on them in an agile manner (Teece, 2007).

**Text box 1 – First-mover advantage**

In addition to the three perspectives, the concept of ‘first-mover advantage’ examines how firms can gain a competitive advantage by being the first to enter a new market. According to Liebermann and Montgomery (1988), unique resources, foresight – i.e. the ability to look ahead – or ‘coincidence’ can create asymmetry, enabling one or more firms to create a market before others. Three complementary mechanisms enable such first movers to maintain their lead:

- › Technological leadership: By being the first to enter a new market, a firm can benefit from potential learning effects, such as a decrease in (production) costs as more experience is gained. First movers can also gain a temporary, legal advantage through patents. Finally, a first mover can establish a technological standard or “dominant category/design” in the market (Suarez et al., 2015), to which others will conform.
- › Appropriation of scarce assets: An information advantage can enable a firm to acquire essential assets such as natural resources and production facilities earlier, more cheaply, or in greater numbers. This does not only concern the appropriation of geographical or tangible assets. Markets also have an implicit limit to the number of different products or services that can be offered.
- › Switching costs: Once customers have committed to an initial product, increasing returns, brand loyalty, and various types of costs – transaction costs, learning costs, contract costs – can prevent them from switching to another provider (Arthur, 1989; David, 1985).

Despite the potential benefits of a first-mover advantage, this lead can also be a hindrance in the longer term (Liebermann and Montgomery, 1988). For example, competitors can learn and benefit from the experiences of a first-mover, enabling them to quickly develop similar value propositions at lower cost and with less uncertainty (‘fast-followers’). First movers are also prone to inertia and lock-ins, making it more difficult for them to adapt to changing market conditions and needs (Christensen & Bower, 1996; Henderson & Clark, 1990).<sup>3</sup>

<sup>3</sup> Chapter 4.1 goes into more detail about how firms can maintain market power by means of barriers to entry.

## 3.4 Discussion: control points from a business perspective

From the micro perspective on control points, the focus can be placed on the strategies that firms can use to gain and maintain a competitive advantage. Based on strategic management literature, the acquisition of control points therefore depends on *market conditions* and the availability of *strategic resources and (dynamic) capabilities*. Firm resources and competencies are considered strategic when they are economically valuable, unique, and difficult to imitate and replace. By applying these criteria to the activities of firms themselves, a definition of control point can be derived.

From a business perspective, a control point is then defined as **a unique and (economically) valuable business activity that is difficult to imitate and replace**. Under this definition, a business activity is unique when there are few or no competitors in the current value chain offering the same value proposition. When the business activity is difficult to imitate and replace, the threat of new entrants and substitute goods is relatively low.

Cost leadership and differentiation are two generic strategies that firms can use to gain a competitive advantage, depending on market conditions.<sup>4</sup> However, it is currently unclear under which market conditions and through which generic strategies control points seem to arise and thrive. On the other hand, it is plausible that acquiring control points is partly dependent on possessing and being able to utilize (a combination of) **strategic resources and competencies**. Table 3.1 provides an overview of the dimensions with which firms can acquire a control point. Firms can have these strategic resources and competencies at their disposal either directly (within the organization) or through others in the ecosystem. In concrete terms, having such strategic resources and competencies at their disposal can help a firm anticipate a new market or respond to changing market conditions sooner than other parties. In addition, strategic resources and competencies can enable firms to ward off competitors because the scarce resources required for market entry have already been appropriated.

Although strategic resources and competencies play an important role in achieving a control point or competitive advantage, it is difficult to explain their emergence exhaustively. This is partly due to causal ambiguity about the exact role of strategic resources and competencies, but also about the influence of path dependencies, market conditions, and social interactions. For these reasons, control points cannot be fully created in advance; their targeted creation involves a high degree of uncertainty. Nevertheless, future research may offer new insights into the emergence and development of control points, based on cases from the Netherlands.

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<sup>4</sup> Further implications of market conditions on control points – such as the power of buyers or suppliers, and the threat of new entrants or substitute goods – are highlighted in the network perspective.

**Summary: control points from a business perspective**

Focus: strategies that enable individual firms to gain a competitive advantage.

Definition: a unique and (economically) valuable business activity that is difficult to imitate and replace.

Criteria:

- ) There are few or no other parties offering the same value proposition;
- ) The activity is of (economic) value to the firm;
- ) The threat of new entrants and substitute goods is relatively low;
- ) The firm possesses and utilizes (a combination of) strategic resources and competencies.

Open questions:

- ) Under what market conditions do control points arise?
- ) What strategies are used to acquire and subsequently maintain control points?
- ) Are certain strategic resources and competencies more important than others? How does this differ per market or sector (and stage of maturity)?

**Table 3.1:** Dimensions of strategic resources and capabilities for a control point<sup>5</sup>

Dimensions resources & capabilities	Explanation
Technological	Technological knowledge and assets, both tangible, codified, and implicit ('tacit')
Production process	Production resources, facilities, and capacities
Partners and suppliers	Economic partnerships, access to materials, knowledge, and skills, vertical integration, etc.
Customers	Domain and market knowledge, customer relationships, co-creation, customer loyalty, customer base, network effects, etc.
Distribution	Transport and sales channels
Business model	Value proposition, revenue model, sources of income, diversification, etc.
Services	Marketing, sales, service, maintenance, etc.
Complementary goods	Products and services that strengthen the value proposition
Infrastructure	Supporting physical and digital infrastructure
Data	Access to data (bases), retrieval, analysis, and utilization of data
Institutions	Compliance with laws and regulations, certification, standards, values, etc.
Networks	Embedding in ecosystems, clusters, innovation hubs, platforms, etc.
Dynamic capabilities	Exploring new (technological, economic, and geopolitical) developments and anticipating and acting on them
Organizational enabling	Leadership & management, talent & HRM, organizational culture, procurement, legal, logistics, etc.

<sup>5</sup> Resources & capabilities can also be described as assets & capabilities; the NXTGEN Hightech Growth Fund program, for example, uses the latter terminology.

### **ASML's control point from a business perspective**

ASML engages in a unique and economically valuable business activity within the semiconductor industry: developing and supplying EUV lithography machines that are necessary for the production of advanced chips. The technological complexity and high costs of developing machines make it difficult for competitors to imitate or replace ASML's technology. This ensures that the threat of new entrants and substitute goods is relatively low.

ASML's competitive advantage is strongly linked to the strategic resources and competencies at its disposal. These extend beyond in-depth technological expertise in areas such as lithography, optics, mechatronics, and software. ASML's strategic resources and competencies also include close partnerships with suppliers and chip manufacturers, as well as the ability to continuously invest and look ahead. In addition, ASML is strongly anchored in the Brainport ecosystem. While ASML initially benefited from some of Philips' resources and competencies, the firm now benefits from collaboration, knowledge sharing, and the specialized labor market in the region.

ASML's control point has therefore arisen partly from a combination of its own strategic resources and competencies, and partly through collaboration with other players in the ecosystem. At the same time, coincidental market developments and uncertain technological choices – such as the focus on DUV technology at the time – have also shaped ASML's position in the market. These uncertainties and path dependencies make it difficult to replicate ASML's success in a targeted and certain manner.

## 4 Network perspective

Innovations do not arise in isolation or entirely within individual firms. They are the result of collective activities and mutual interactions in networks consisting of firms, governments, knowledge institutions, and other entities. The network perspective on control points therefore focuses on the dynamics between parties that are united in a network, such as a value chain, market, or ecosystem. The influences of firm and the dependencies they create within such networks are central to this perspective and are typical of control points. With their iOS and Android operating systems, for example, Apple and Google exercise control over access to and distribution of applications within these platform ecosystems. As a result, other parties in this network, such as app developers and consumers, are heavily dependent on them.

This chapter summarizes literature on market power, value chain governance, and innovation ecosystems, on the basis of which a network perspective on control points is then derived.

### 4.1 Market power

Market power means that a firm (or group of firms) has substantial influence over the price of a product or service in a particular market (Syverson, 2019). This gives firms with market power (indirect) influence over other actors – suppliers, competitors, and customers – and their prices in the market.

Strictly speaking, the extent of a firm's market power is related to the difference between the market price and the marginal costs of a product.<sup>6</sup> When the market price remains above the marginal costs, a firm makes a profit and, in theory, can be said to have market power. In practice, however, it is difficult to determine the marginal costs of a product with any certainty. Market power is therefore expressed using other indicators. The most commonly used indicator of market power is market concentration: a firm's share of a particular market or industry, usually based on turnover (Syverson, 2019).<sup>7</sup> However, this indicator also has its limitations. For example, many markets cannot be clearly defined, and the market concentration indicator does not provide insight into a firm's profitability. Practice shows that having a significant market share does not necessarily mean that a firm is making a profit.

A firm's market power depends primarily on interacting market conditions: the number of suppliers, the distinctiveness of the supply, the number of customers, and its importance to the customer. The more important the product or service is to the customer and the greater the demand, the greater the market power of the firm offering it (*ceteris paribus*). The fewer suppliers and alternatives there are on the supply side, the greater the market power of this firm. In perfect competition—a market form with homogeneous products and a large number of both suppliers and buyers—suppliers have little influence on price and therefore little market power. In other market forms, such as oligopoly, monopoly, and monopolistic competition, there are fewer suppliers or the products offered are more heterogeneous, which means that suppliers often have a greater degree of market power.

<sup>6</sup> Marginal costs are the costs incurred by producing one additional unit of a product. In economic terms, the difference between the market price and marginal costs is also expressed as the "mark-up" and Lerner index.

<sup>7</sup> Market concentration is often expressed by means of the concentration ratio or the Herfindahl index.

**Distinctiveness** – the ability of a product and/or supplier to distinguish itself from competitors – is also a prerequisite for the emergence of market power. However, this is not sufficient to explain the existence of market powers. Once acquired, market power must also be maintained.

The continuity of market power can be attributed in particular to the creation, whether conscious or not, of **barriers to entry** that (new) firms must overcome in order to enter a particular market (White, 2013). There are various types of barriers that influence the degree of competition within a market.

1. Firstly, large, established firms can often offer products or services at lower costs through *economies of scale*, as they can spread the costs over a larger production volume (increasing returns). Examples of this are having efficient production facilities or being able to purchase large quantities of raw materials and components.
2. In addition, *capital costs* can form a barrier to new entrants. These are high initial investments, for example in R&D and factories, which are necessary to enter a market. These (sunk) costs cannot be recovered when withdrawing from the market, which makes entering the market more risky. A classic example of this is investment in physical assets such as the construction of a factory. Nowadays, intangible assets such as advanced ICT systems and associated infrastructure also constitute high barriers to entry (De Ridder, 2024).
3. Established firms can also *appropriate scarcity* by owning geographically scarce locations or raw material sources, building strong relationships with producers and distributors, or having legal protection. Legal protection can take the form of licenses, giving only a few parties access to a market segment (e.g., taxi services or network operators), or through patents and intellectual property.

In addition to – and by means of – the above barriers to entry, established firms may engage in strategic behavior to deter new entrants or competitors. For example, through price reductions, increased marketing expenditures, exclusive contracts with customers or suppliers, or through acquisitions and mergers.

## 4.2 Governance of value chains

Whereas market power allows parties to influence each other indirectly through pricing, value chain governance allows them to do so more directly. **Value chain governance** can be defined as ‘the authority and power relationships that determine how financial, material, and human resources are allocated and flow within a value chain’ (Gereffi & Fernandez-Stark, 2016).<sup>8</sup> Five ideal-typical forms of governance are distinguished (see Figure 4.1), based on the complexity of the information to be shared in the chain, the way in which information can be explicitly recorded, and the level of competence of suppliers (Gereffi et al., 2005).<sup>9</sup> The resulting forms of governance are:

<sup>8</sup> Due to increasing globalization and international trade, value chains are no longer limited to geographical boundaries, which is why there is now increasing talk of international value chains. The geopolitical and geoeconomic aspects involved in this are taken into account in the macro perspective on control points.

<sup>9</sup> In practice, multiple forms of value chain governance can coexist, and the form of governance can also change as an industry develops further.

1. **Market-based governance:** in this form of governance, transactions are relatively simple, information about product characteristics can be easily shared, and suppliers can manufacture these products independently. As a result, there is little cooperation and the switching costs between suppliers or customers are low.
2. **Modular governance:** here, suppliers manufacture products based on detailed specifications from purchasing firms. The transactions are more complex, but the information can be codified, allowing interaction to be standardized.
3. **Relational governance:** this form of governance is based on mutual trust and long-term interactions between firms. This is because the transactions are complex and information cannot be easily shared. While this leads to strong mutual dependencies, the purchasing firm still specifies the demand and thereby exercises a certain degree of control over the suppliers.
4. **Captive governance:** Value chains in this form are characterized by asymmetrical power relationships, with small suppliers tied to and dependent on one or a few purchasing firms. These purchasers have a great deal of control over the value chain and largely determine the conditions that suppliers must meet. However, due to the close and specialized relationship between suppliers and purchasing firms, both face high switching costs.
5. **Hierarchical governance:** vertical integration is central to this form of governance. The entire production process takes place within a single firm, giving that firm complete control within the value chain. This is often the result of complex, non-codifiable information or the lagging competencies of suppliers.

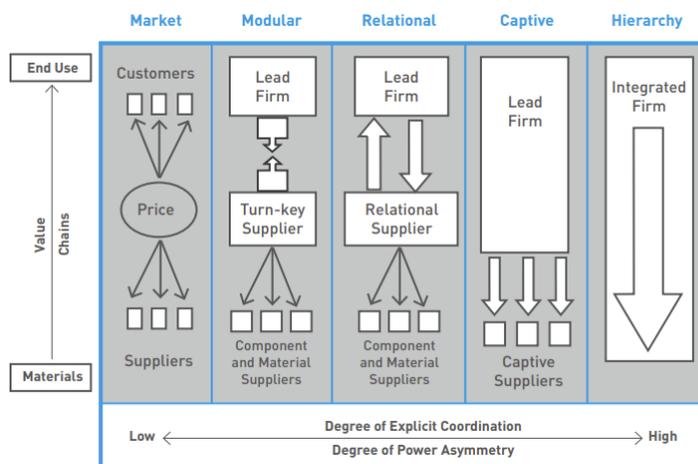


Figure 4.1: Types of value chain governance, from Gereffi & Fernandez Stark (2016)

Although a value chain is characterized by a variety of parties, value chain governance literature emphasizes the role of “**lead firms**” in particular. Although there is no specific definition of the term here either, lead firms are generally regarded as major market or technological leaders, characterized by superior market capitalization and relatively high R&D investments (Kano et al., 2020). Jacobides and Tae (2015) refer to these firms as ‘kingpins’ and demonstrate that they both create positive spillovers for the market (including for competitors) by ‘increasing the pie’ and cause bottlenecks by gradually exercising more control and appropriating value.

Kano et al. (2020) distinguish between **two levels of value chain governance** that lead firms undertake, namely structural and strategic governance.

1. **Structural governance** addresses structural decision-making around economic activities. This includes how the organizational structure of the value chain is determined; which parties participate, which activities are integrated or outsourced in the value chain, and at which geographical locations these take place.

Lead firms often have substantial control and influence over decisions to integrate or outsource activities within the value chain. In addition to macro-level characteristics such as labor costs, policy, and regulations, the geographical locations where these activities take place are also influenced by the choices made by lead firms. Access to strategic assets explains much of the geographical configuration of value chains. This is particularly the case for knowledge-intensive industries.

Lead firms also play a dominant role in the network structure of value chains – which parties are active within them and how they interact with each other. A lead firm typically has a higher number of direct links than and with other parties in the value chain. As a result, the lead firm can exert more power and influence over them. However, it is not only the number of links that determines the lead firm's position of power; other network characteristics such as the 'density' and 'diversity' of the value chain also have an influence.

2. **Strategic governance**, on the other hand, concerns the dynamics and interactions between the various actors, focusing on how actors learn from each other and share resources, and how participating parties and the value chain as a whole are coordinated. Strong links, initiated or facilitated by lead firms, appear to play an important role in disseminating and building new knowledge within the value chain. Specific mention is made of improving or 'upgrading' the capabilities of suppliers, something that benefits both the suppliers and the lead firm.

However, it is not only the R&D knowledge and activities of the lead firm that explain the creation of value in the value chain. The functioning of value chains also appears to be highly dependent on the ability of lead firms to orchestrate (build, coordinate, and support) a network of actors and resources. In particular, facilitating informal relationships, for example by encouraging structural communication and interactions or by creating connectedness and a shared identity, appears to stimulate the innovative capacity of the value chain.

Finally, value chains not only create value, they also appropriate it and distribute it. Once again, lead firms play a dominant role here. Lead firms are characterized by their ability to appropriate a substantial portion of the value created in the chain and distribute the remainder, resulting in power dynamics and potentially unequal relationships.

## 4.3 Innovation (eco)systems

Whereas individual firms used to be regarded as the drivers of innovation, a more systemic view of innovation has emerged since the 1980s. This systemic view emphasizes the interactions between different types of actors and other factors in the development and diffusion of innovation. Since then, various innovation (eco)system perspectives have been formed that address the interdependencies between actors in networks.

Literature on **innovation systems** describes how interactions between actors, institutions, and infrastructure influence innovation processes within a specific context to create (future) value that firms can appropriate. The first innovation systems were mainly characterized by geographical boundaries, such as national innovation systems (NIS) and regional innovation systems (RIS; Lundvall et al., 1988; Nelson, 1993; Cooke, 1992). These have been followed by frameworks with a more thematic focus and demarcation, such as sectoral innovation systems (SIS), technological innovation systems (TIS), and mission-driven innovation systems (MIS) (Malerba, 2002; Hekkert et al., 2007; 2020).

These different innovation systems recognize the dependencies between actors in innovation processes; in order to innovate and create value, actors depend on the expertise and knowledge (sharing) of others. For example, firms that depend on technological breakthroughs from fundamental and applied research within knowledge institutions, or on the production capacities of suppliers. In addition, the literature on innovation systems also addresses institutional dependencies (through legislation and regulations, standards and norms, for example) and the role of government in creating these institutional frameworks to stimulate or even coordinate innovation between actors within the innovation system (cf. Elzinga et al., 2023; Wesseling & Meijerhof, 2023).

Simultaneously with innovation systems, other concepts also emerged, such as **clusters** (Porter, 1990), **inter-organizational collaboration** (Ahuja, 2000; Gulati, 1995), **open innovation** (Chesborough, 2003), and **ecosystems** where mutual dependencies play an important role in stimulating innovation and competitiveness. Drawing on ecology, Moore (1993) coined the term 'business ecosystems'. This led to a series of conceptualizations of ecosystems, including 'innovation ecosystems' (Adner, 2006) and 'entrepreneurship ecosystems' (Stam, 2015). Compared to innovation systems, these ecosystem approaches specifically address economic complementarities, mutual technological dependencies, and value creation and appropriation by organizations (Baldwin et al., 2024). In addition, the concept of 'research and innovation (R&I) ecosystems' has been introduced in national government policy (EZK, 2019). Focused on conscious collaboration between actors based on shared interests, the frameworks for R&I ecosystems bring together the literature on both innovation systems and ecosystems (TNO, 2023, 2020; Dialogic, 2020). Within the NXTGEN Hightech Growth Fund program, such an R&I ecosystems framework is applied to stimulate the Dutch high-tech ecosystem and the acquisition of control points within it.

Finally, more recent research emphasizes the way in which value is created and appropriated in such a multi-stakeholder context. This research highlights the complexity of securing the cooperation of a large and diverse group of actors, as it becomes difficult to identify the role and contribution of individual actors to value creation and related value appropriation (Geurts et al., 2022; Rouyre, 2024). In addition, research shows that it is precisely innovation and the entry of new actors with these innovations (e.g., entrepreneurs, startups, or new intermediary players) that can influence the strategic positioning of actors in such an ecosystem. As a result, key positions in an existing ecosystem of interdependent parties can change (Geurts & Cepa, 2023).

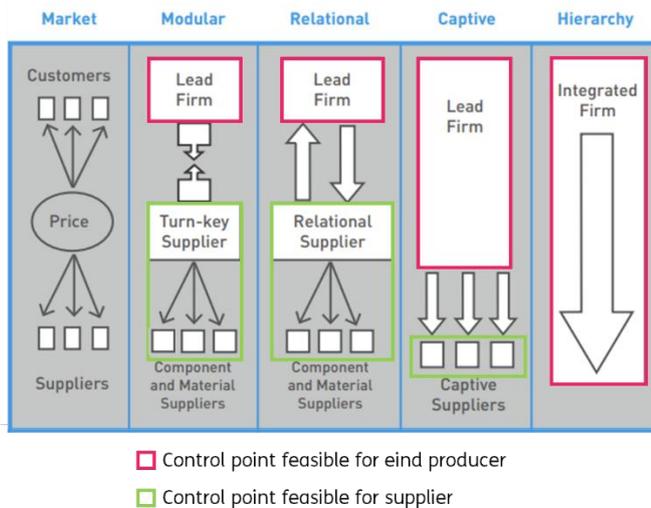
## 4.4 Discussion: control points from a network perspective

The network perspective on control points focuses on the influences and dependencies within networks. Firms exert influence on the activities and earning capacity of other parties through market power (price setting) and value chain governance. Such a position of power within a market or value chain can be seen as a control point. A control point is related, among other things, to the uniqueness of the business activity and the number of competitors offering alternatives (as described in the business perspective on control points). The more unique the activity and the less competition there is, the greater the market concentration and position of power, and therefore the more influential the control point. In addition, the network perspective on control points not only focuses on competing firms, but also on the influences and dependencies in relation to suppliers and customers.

From the network perspective, a control point can therefore be defined as **a unique and influential business activity on which other parties in the network are heavily dependent**. Firms that possess control points thus exhibit similarities with what are referred to in the literature as “lead firms” (or kingpins). These are described as major market or technological leaders, characterized by superior market capitalization and relatively high R&D investments, which take on the governance of value chains and appropriate a substantial part of the value created within them. While lead firms are mainly described in the literature as end producers (OEMs) or end traders (think, for example, of a firm such as Philips), control points under this definition can also be acquired by suppliers (think, for example, of a firm such as ASML).

Control points can therefore exist in value chains with a modular, relational, captive, or hierarchical governance structure (see Figure 4.2). In these forms, there are strong dependencies for suppliers and/or customers. Given the similarities with lead firms, it is assumed that firms with control points take on the structural and strategic governance of value chains. Structural governance concerns control over and coordination of which parties participate in the chain, which parties perform which activities, and where these activities take place (geographically). Strategic governance addresses the sharing and building of new knowledge and resources, upgrading the capabilities of suppliers, facilitating interactions, and distributing the value created within the value chain. It is currently unknown how the characteristics of firms with a control point differ per type of value chain and to what extent these firms also address both levels of value chain governance in practice.

Once a control point has been acquired, entry barriers ultimately ensure that this position is then consolidated. Entry barriers, such as economies of scale, high capital costs, and appropriation of scarcity, hinder new competition and can ensure that the business activity remains influential and unique in the future. The network perspective thus complements the business perspective on control points by identifying strategies that firms can use to create barriers to entry and thereby maintain their competitive advantage (for explanation, see, for example, Figure 4.2). Finally, governments can also create, maintain, or reduce barriers to entry through innovation and industrial policy. For example, by establishing specific regulations and standards to discourage foreign competitors or by facilitating market access through competition law.



**Figure 4.2:** Possibility for control points within the value chain types of Gereffi & Fernandez-Stark (2016)

**Summary: control points from a network perspective**  
 Focus: influences and dependencies within networks such as markets, value chains, and ecosystems.

Definition: a unique and influential business activity on which other parties in the network are heavily dependent.

Criteria:

- ) The firm influences the activities and earning capacity of other parties, for example through pricing and/or value chain governance.
- ) Suppliers and/or customers are heavily dependent on the business activity.
- ) The business activity is unique and has few competitors offering alternatives.
- ) There are barriers to entry that hinder future competition.

Open questions:

- ) To what extent do different sources/forms of influence (such as pricing and value chain governance) create dependencies in the network?
- ) What value chain governance activities do firms with a control point engage in?
- ) How do the influences and dependencies of control points differ between the various types of value chains?
- ) How can barriers to entry for control points be created or reduced through policy?

**ASML's control point from a network perspective:**

ASML occupies a unique and influential position within the semiconductor industry. Currently, there are no other firms offering state-of-the-art lithography technology or alternatives to it. This gives ASML a natural monopoly position from which it plays a crucial role in the semiconductor value chain.

ASML's dominant position is reinforced by the strong dependence of leading chip manufacturers, such as TSMC, Intel, and Samsung. These manufacturers are completely dependent on ASML's chip machines for their most advanced chips. This gives ASML a high degree of influence on pricing in the value chain. Suppliers such as Zeiss and Trumpf are also heavily dependent on ASML for their earning capacity. However, these dependencies cannot be described as one-sided, as ASML relies on its suppliers for the development of unique components. Suppliers can therefore also have control points and create (mutual) dependencies. At the same time, ASML is dependent on the continuity of demand and the unique position of its customers.

Finally, barriers to entry contribute to preventing new competitors from entering the market, such as high R&D investments and long-term development and supply contracts with chip manufacturers. This has enabled ASML to maintain its dominant position in the market to date.

# 5 Geopolitical and geoeconomic perspective

A third way of looking at control points is from a geopolitical and geoeconomic perspective. Increasing international tensions and dependencies are putting pressure on the autonomy and sovereignty of countries and supranational collaborations. Striking examples of this are not only Europe's dependence on critical raw materials and energy technologies from China (Rietveld et al., 2022; TNO & HCSS, 2024), but also its dependence on firms in the United States for digital services and (cyber) security (TNO, 2024b). In the field of cloud storage and services, for example, European firms and governments are at the mercy of Amazon Web Services, Microsoft Azure, and Google Cloud Platform.

As a result of these socio-technological and economic challenges, we are seeing the emergence of a geopolitical and geoeconomic perspective on control points, which focuses on strengthening international value chains and innovation ecosystems in order to gain a position of control (cf. Kroll & Frietsch, 2022). Countries are specifically focusing on specialising in key technologies and knowledge-intensive activities within high-tech value chains, because substantial value can be appropriated here (Edler et al., 2023). From this perspective on control points, a link is therefore made with technological sovereignty & open strategic autonomy and strategic innovation assets. Text box 2 also discusses terms that are closely related to control points, such as chokepoints, bottlenecks, and vital infrastructure.

## 5.1 Technological sovereignty & open strategic autonomy

*Technological sovereignty* and *open strategic autonomy* (OSA) are two closely related terms. Technological sovereignty is defined as “*the ability of a state or a federation of states to provide the technologies it deems critical for its welfare, competitiveness, and ability to act, and to be able to develop these or source them from other economic areas without one-sided structural dependency*” (Edler et al., 2023, p. 2). This definition rejects the connotation that technological sovereignty aims to be completely technologically independent and self-sufficient. On the contrary, the definition recognizes that unilateral dependencies and the risks associated with them should not be treated naively. According to Edler et al. (2023), technological sovereignty positions itself between these two extremes, whereby it should be understood and used as a means for a state to **act independently and provide for itself in the field of technology and innovation**. Technological sovereignty is not only about access to critical raw materials and components, but also about developing complete product innovations and steering the development of international markets.

Strategic autonomy also refers to the ability of a country or region to pursue strategically important (policy) activities independently without foreign influence (Kroll, 2024). 'Open' strategic autonomy adds international openness and cooperation to this definition, recognizing that no country or region can become completely independent or self-sufficient in today's interconnected world. While OSA and technological sovereignty have similar

definitions, OSA looks at the general capacity of states to act in the geopolitical and institutional context.

Both technological sovereignty and OSA thus address the ability of states to act independently and provide technologies. This ability is essential for three central functions that states perform (Edler, 2020; Kroll, 2024). These functions are: safeguarding political sovereignty and national security, providing for broader societal needs (public services such as healthcare), and promoting economic viability and competitiveness. Changes in the global innovation system have put these functions under pressure, resulting in an increasing policy focus on OSA and technological sovereignty.

The ability to independently provide crucial technologies stems from a combination of one's **own (domestic) capabilities and dependence on external (international) economic networks** (Edler et al., 2023; Kroll, 2024). This external dependence does not necessarily entail inherent uncertainty and risk. Edler et al. (2023) argue that dependence on external networks can be just as reliable as reliance on one's own capabilities. Uniting under a joint political and economic entity (such as the European Union) is the most robust, but also the most exceptional example of this. More common, but also 'weaker' ways in which this can be achieved are international collaborations based on shared political and social values (EU and the US) and collaborations on purely technological and economic grounds (EU and China).

External dependence does not necessarily have to undermine the strategic autonomy or technological sovereignty of states. Only when external dependence is concentrated on a limited group of parties and there is a substantial risk that these parties will sever this relationship can we speak of a lack of autonomy (Kroll, 2024). Mathematically speaking, strategic autonomy can therefore be defined as autonomy in relation to the risk-weighted concentration of dependencies, whereby autonomy refers to the relationship between one's own capacities and external dependencies. Strategic autonomy therefore increases with a strengthening of one's own capacities, a reduction in external dependencies, and a reduction in the concentration and risks of these dependencies.

Finally, OSA can be further operationalized. A distinction can be made between two dimensions of autonomy: economic and innovation autonomy (Kroll, 2024). **Economic autonomy** relates to aspects of value creation and external dependencies in access to raw materials, materials, and production facilities. **Innovation autonomy** concerns aspects related to knowledge creation and the extent to which countries can innovate independently and control the direction of innovation processes. These dimensions of autonomy can then be applied and analyzed at the level of (key) technologies as well as at the level of research and innovation ecosystems (cf. Kroll, 2024).

## 5.2 Strategic innovation assets

Control points also have an obvious overlap with strategic innovation assets (SIA), an analytical framework for gaining insight into innovation assets that play a critical role in the future competitiveness and prosperity of the Netherlands (TNO, 2019). Within this analytical framework, which builds on the work of Teece (1986, 2006, 2018), ‘innovation assets’ can be classified as strategic if they meet at least three of the following dimensions, including at least the first two:

- › The innovation asset is distinctive, i.e., it is unique;
- › There are strong dependencies in the value chain;
- › The innovation asset has economic mass;
- › The innovation asset addresses a societal challenge or demand (societal importance).

Within the SIA framework, innovation assets can be defined at three different levels (see Figure 5.1). These levels show similarities with the perspectives on control points highlighted in this study. At the lowest SIA level, individual technological and complementary innovation assets can be considered strategic. Examples include in-depth knowledge embedded in a patent or a unique production facility. This level can be compared to the strategic resources and competencies from the business perspective on control points. However, the SIA framework also includes the societal importance of resources and competencies for future prosperity, whereas the business perspective on control points focuses more on their private importance for individual firms (competitive advantage).

The other two levels of the SIA framework also tie in well with the geopolitical and geoeconomic perspective on control points. Within the SIA framework, actors and (parts of) networks can also be regarded as innovation assets. After all, technologies, resources, and competencies often belong to the capital of individual firms or institutions. In addition, these can also be found in the broader network of which organizations are part. Such value chains, clusters, and regional research and innovation ecosystems can therefore also constitute a strategic innovation asset in themselves. ASML cannot function without the ecosystem of suppliers, knowledge, educational, and financial institutions. That “ASML ecosystem” is, in turn, an important component of the “Brainport ecosystem.”

From a geopolitical and geoeconomic perspective on control points, the emphasis can be placed on firms and networks that have strategic resources and competencies and are therefore themselves (as strategic innovation assets) important for the international competitive position and future prosperity of countries. Compared to the business and network perspective on control points, social importance therefore plays an important role within this perspective. The earlier perspectives focus primarily on the private (economic) interests of firms. When firms have both private and public interests at stake – whereby social interests do not necessarily have to be internalised by firms – these interests may conflict with each other and the question arises as to how they should be weighed against each other.<sup>10</sup> External incentives (e.g., regulation, pricing, or subsidies) may then be necessary to ensure that both interests are safeguarded.

<sup>10</sup> Chapter 6 discusses this in more detail.



Figure 5.1: Analysis levels of strategic innovation assets from TNO (2019)

**Text box 2 – Chokepoints, bottlenecks, vital infrastructure, and control points**

Originally, chokepoints or bottlenecks, based on military strategy, referred to a strategic and narrow passage to a geographical region (e.g., the Suez Canal).<sup>11</sup> In business administration, and specifically supply chain management, these terms are also used to indicate *critical points* that can disrupt the *flow of goods, services, or information* and thus *halt or delay the supply chain* (Mizgier et al., 2013).

Vital or critical infrastructure is defined as the fundamental processes, services, and systems that are essential to the continuity of the economy and society.<sup>12</sup> Vital infrastructure is characterized by the *extensive and serious social consequences* that result from its *absence* (due to failure, disruption, or manipulation). Examples of vital infrastructure include drinking water supplies, energy distribution, internet access, and payment transactions.

A similar characteristic with control points from a geopolitical and geoeconomic perspective is that their importance can be expressed in terms of the societal consequences that arise in the event of their absence or disruption. In addition, the terms also address a question of perspective and ownership; a control point for one person is a potential chokepoint or bottleneck for another.

<sup>11</sup> See <https://www.merriam-webster.com/dictionary/choke%20point>

<sup>12</sup> See <https://www.nctv.nl/onderwerpen/v/vitale-infrastructuur>, [https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12462-Protecting-critical-infrastructure-in-the-EU-new-rules\\_en](https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12462-Protecting-critical-infrastructure-in-the-EU-new-rules_en), and <https://nipv.nl/onderwerp/vitale-infrastructuur/>

## 5.3 Discussion: control points from a geopolitical and geoeconomic perspective

The geopolitical and geoeconomic perspective on control points examines international dependencies and the role of innovation capacity in the economy and society. Technology and innovation play an essential role in the international competitiveness and economic earning capacity of states, and the social needs within them. The ability to innovate independently and to provide (key) technologies is therefore central to this perspective. In this context, independence does not equate to self-sufficiency; it refers to the ability to act independently in innovation processes and in providing technologies. Both domestic capacities, firms, and networks, as well as external dependencies, are important here.

From this perspective, a control point can be defined as **a (concentrated network of) business activity(ies) on which the innovative capacity and thus the public functions of states are heavily dependent**. In contrast to earlier perspectives, in which a control point is described as an activity of an individual firm, a control point within this perspective can also refer to a network of business activities. After all, innovations do not arise in isolation or entirely within individual firms. The innovative capacity of states therefore depends on collective activities and mutual interactions within networks. A control point can therefore also encompass concentrated activities within (part of) a value chain, cluster, or ecosystem.

A control point exists when these business activities substantially influence the innovative capacity of states and their primary public functions. Innovative capacity is understood here as the ability to develop, produce, and supply new technologies. The public functions of states in this context concern safeguarding political sovereignty (national security), meeting broader social needs (public services such as healthcare and addressing social challenges), and promoting economic earning power and competitiveness. Substantial influence, or strong dependence, exists when these activities are unique and their loss leads to a lack of capacity to innovate and fulfill public functions.

**Summary: control points from a geopolitical and geoeconomic perspective.**

Focus: international dependencies and the social role of innovative capacity.

Definition: a (concentrated network of) business activity(ies) on which the innovative capacity and public functions of states are heavily dependent.

Criteria:

- ) The business activity or activities are unique or concentrated;
- ) The innovative capacity of states is substantially influenced by the business activity or activities;
- ) The business activity or activities contribute to safeguarding political sovereignty (defense and public safety), meeting social needs (public services such as healthcare), or promoting economic earning power and competitiveness.

Open questions:

- ) When are dependencies too one-sided and what are the potential vulnerabilities for the Netherlands?
- ) How do control points create opportunities for the Netherlands, now and in the future?
- ) What role should national and/or European policy ideally play with regard to control points?

**ASML's control point from a geopolitical and geoeconomic perspective:**

Geopolitically, ASML's machines are directly and indirectly crucial for other states to serve their public interests. ASML is the world's only supplier of advanced (EUV) lithography machines, which are essential for the production of semiconductors. With a turnover of €27.6 billion in 2023 and R&D expenditure of €4 billion (of which €2.8 billion in the Netherlands), ASML contributes substantially to the Netherlands' innovation and earning capacity.<sup>13</sup> ASML's unique lithography machines are also crucial to the innovative capacity of states, as semiconductors form the basis of modern and future electronics and information technologies, such as telecommunications networks, artificial intelligence, and cloud computing. A disruption in ASML's activities would therefore have far-reaching consequences for the global chip industry and economy. This is because the absence of this critical link – and of alternatives to it – would not only disrupt the production of semiconductors, but also seriously hamper the development of technologies that depend on these chips.

ASML's unique business activity is not only of economic importance, but also has geopolitical implications due to its impact on national security. After all, ASML's machines can be used by states to develop advanced chips for both civilian and military applications. The licensing rules established for the export of ASML chip machines explicitly address this dependency and potential vulnerability. These rules aim to prevent other states, including China, from gaining economic and military superiority. ASML's business activities therefore have an impact on various public interests, in addition to private interests.

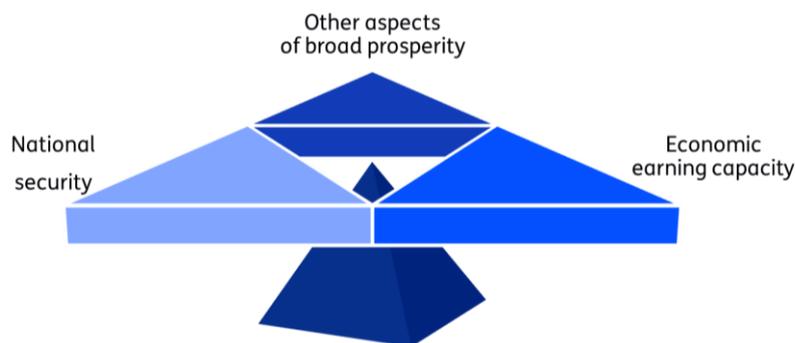
<sup>13</sup> See <https://www.asml.com/en/investors/annual-report/2023#2023-annual-report> and TW, TNO & VNO-NCW (2024).

# 6 Opportunities and vulnerabilities

Control points fulfill various social roles. First, they contribute to economic earning capacity by stimulating investment power and innovation. Control points also help to safeguard national security, as Dutch control points strengthen reciprocity and resilience in relation to dependencies on control points from abroad. In addition, control points touch on more aspects of broad prosperity. Thanks to the innovative capacity of control points – for example, in the field of hydrogen or wind turbines – they not only increase Dutch earning capacity, but also contribute to the achievement of energy and climate goals. Or the development of smart agricultural technologies by control points can reduce the use of water and pesticides, benefiting biodiversity and soil quality.

In short, the roles that control points fulfill and the interests they influence extend beyond economic profitability and competitiveness. Control points also influence the ability to guarantee national security and address broader societal needs and challenges. Figure 6.1 illustrates the balance between economic profitability, national security, and other aspects of broad prosperity. Geopolitical and technological developments and dependencies are inextricably linked to control points and put pressure on this balance.

Industrial and innovation policy based on broad prosperity can play an essential role in responding to the opportunities and vulnerabilities of control points. Policy interventions with regard to control points are justified when the ability to innovate independently and provide technology is compromised, thereby jeopardizing public interests such as national security, economic earning capacity, and other aspects of broad prosperity (Edler et al., 2023). Based on the perspectives described in this literature review, this chapter further explores the opportunities and vulnerabilities of control points and the justification for policy interventions in this regard.



**Figure 6.1:** Different aspects of broad prosperity around control points

### **Leveraging control points for the future earning capacity of the Netherlands**

Firms with control points influence other parties in value chains and markets. From this position, they have the resources, economies of scale, and relationships to invest in innovation. Firms with control points exercise investment power and stimulate product and process innovations that can benefit both customers and the sector (suppliers and competitors). Through close partnerships and specific requirements, Apple and NVIDIA, for example, encourage innovation among parties in the semiconductor industry, such as TSMC and ASML. Control points thus generate interest not only in the private sector, but also in the government, in order to stimulate future earning capacity.

On the other hand, control points can also entail risks of market and system failure. Monopoly positions, cartel formation, and abuse of power are examples of potential market failure, which can result in high prices, limited innovation, and poor international competitiveness, among other things. A Dutch example of an inefficient monopoly was KPN's position in the telecommunications market, which has been increasingly liberalized since the 1990s to stimulate competition and innovation. Lock-ins are another example of potential system failure, whereby dominant parties and close-knit networks create an innovation system that is too inward-looking and therefore lags behind new technological developments (Weber & Rohracher, 2012). In the mobile phone industry, for example, dominant firms such as Nokia and Blackberry clung to their own designs and operating systems for too long, causing them to lose market share with the rise of the touchscreen smartphone. So while control points drive innovation and profitability on the one hand, they can hinder efficient market and system functioning on the other. In order to stimulate future earning capacity with the emergence of new technologies and market dynamics, it is therefore important for governments to both build control points and dismantle obstructive control points.

The geographical spread of economic activities also brings opportunities and vulnerabilities. Nowadays, value chains are highly internationalized, with the development and production of goods spread across multiple countries for reasons of efficiency. This has led to a pattern whereby knowledge-intensive activities, such as R&D and product design, tend to take place in Western countries, while labor-intensive activities, such as production and assembly, have moved to Asian countries. Although this geographical spread offers private and public economic benefits, it has become impossible for many European firms to produce everything themselves, making cooperation with other countries inevitable. A fitting example of this is Europe's dependence on rare earth metals from Chinese firms. The Chinese government is actively committed to low costs and high market share. In 2022, for example, Australian producers were confronted with a Chinese government directive to 'bring prices back to rationality', after which the price fell by two-thirds (The Economist, 2024). This makes it difficult for Western producers to build up profitable capacity. Dependencies therefore bring economic benefits but also come with risks for social, economic, and national security aspects.

### **Leveraging control points for safeguarding national security**

The Dutch government has already noted that geopolitical developments are causing economic and national security interests to become increasingly intertwined (Dutch government, 2020). The chip industry, artificial intelligence, and quantum technology are examples of sectors and technologies that are at this intersection.

Private and public interests play a role here. From the perspective of private economic interests – of firms that own control points within value chains – but also from the perspective of public economic interests, it is beneficial to freely export technologies and products to countries where there is demand for them. Alternatively, it may be advantageous to merge the firm with or acquire it by a foreign party. A striking example of this is the Dutch cybersecurity firm Fox-IT, which was acquired by the British NCC Group in 2015. Fox-IT had a strong reputation for securing state secrets and vital infrastructure, but the foreign takeover raised concerns about the security of this information.

This example, as well as the export restrictions that apply to ASML, shows that economic activities can harm public interests. Information or technologies thus fall into the hands of powers that can use them as economic or geopolitical leverage. This creates tension between safeguarding national security and stimulating entrepreneurship and economic earning capacity (TNO, 2019). By reducing existing dependencies or creating more reciprocity through the use of new control points, the government can continue to guarantee national security.

### **Leveraging control points for achieving transformative goals**

There is a growing realization that transitions do not happen automatically and that they therefore require a different, more active role for the government than simply solving market and system failures. Based on this rationale, we are seeing the emergence of mission-driven innovation policy (Mazzucato, 2018) and transformative innovation policy (Schot & Steinmueller, 2018), in which governments use innovation in a targeted manner to change unsustainable systems and overcome societal challenges. This newer form of innovation policy is characterized by mobilizing investment and innovation through international cooperation to achieve transformative goals (Edler et al., 2023).

Control points can create opportunities for achieving transformative goals. Firms with a control point are not only those that have the capacity to develop transformative innovations, they also contribute, for example, to shaping joint agendas and sustainable chains. Through (international) influences and dependencies, control points can facilitate rapid upscaling and diffusion of these innovations.

At the same time, control points can also be built on principles that are unsustainable in the long term. The dependencies and interests that firms have created with control points—for example, dominant firms in the tobacco or fossil fuel industries—can therefore actually hinder social change. Shell, for example, plays a key role in the transition to sustainable energy and, from its position, can accelerate or slow down the energy transition with strategic agendas and investment choices. In order to achieve transformative goals, it is therefore important for governments not only to focus strategically on new control points, but also to dismantle the (domestic) control points that hinder this.

### **Dutch control points in the global food industry**

International developments mean that food security is becoming a challenge for more and more countries (WRR, 2023): the world population is growing, the production of the global food system is under pressure due to scarce raw materials and labor, climate change, and desertification, while geopolitics is fragmenting.

The Netherlands is a major player in the global food industry (WRR, 2023). Specialized knowledge and in-depth expertise are concentrated in regional ecosystems such as the Food Valley around Wageningen and Seed Valley in North Holland. This brings with it both a responsibility to address international food challenges and a strong geopolitical and geoeconomic position. Examples of Dutch control points in the global food industry from this geopolitical and geoeconomic perspective can be found in seed breeding, food processing, and food products, among others.

#### **Seed breeding and enrichment**

The Dutch seed breeding and enrichment sector specializes in the production of vegetable, flower, and grass seeds and seed potatoes (TNO, 2019). The Netherlands exported €2 billion worth of high-quality vegetable seeds in 2022, compared to €0.5 billion for both the US and France (Rabobank, 2024). This means that the Netherlands represents a significant share of the international availability of vegetable seeds.

The seed breeding sector is an example where Dutch firms do not individually possess a control point, but where the concentrated network of these business activities forms a control point. The Netherlands is involved in the entire innovation chain of fundamental research, breeding, and sales (TNO, 2019). Dutch firms such as Rijk Zwaan, Bejo Zaden, and Enza Zaden develop high-quality seeds that are resistant to diseases and pests, for example. In addition, foreign seed breeding multinationals such as Bayer and Syngenta are also based in the Netherlands. The Netherlands therefore makes an important contribution to the availability of crops and thus forms a crucial link, or control point, in the global food industry.

#### **Food processing and foodstuff**

The Netherlands also has control points in the food processing and food products industry thanks to unique business activity with international influences. For example, the Dutch chemical firm DSM, which merged with the Swiss firm Firmenich in 2023, supplies specialized food ingredients such as vitamins and enzymes that improve the nutritional value and shelf life of products. FrieslandCampina also plays an important role in the dairy industry, with high-quality milk products and ingredients that are exported worldwide. Also related to this industry is the Dutch firm Lely, which develops advanced automation systems for dairy farming and has built up a 50% global market share in the milk robot market. Finally, with its extensive brand portfolio, Unilever—although now wholly British-owned, but with the headquarters of its food division still in the Netherlands—represents a control point in the global food industry.

# 7 Conclusion and policy implications

Although thinking in terms of control points is not new, the concept has taken on a different meaning in recent years. While the classic perspective on control points focuses on individual firms with a competitive advantage, this perspective has been followed by a perspective on control points in the context of value chains and ecosystems. This perspective examines the influences and dependencies within networks, whereby a control point is considered a unique and influential business activity on which other parties in the network are heavily dependent. This has introduced the idea that it is not only a position as an OEM (original equipment manufacturer, such as Philips) that is valuable; such a position of control can also arise elsewhere in the value chain.

In light of recent geopolitical and geoeconomic developments, an additional perspective has been introduced, which addresses strategic dependencies and the societal role of innovation capacity. From this perspective, a control point is defined as a (concentrated network of) business activity(ies) on which the innovative capacity and public functions of states (i.e., safeguarding national security, promoting economic competitiveness and earning power, and meeting broader societal needs) are heavily dependent. The latter perspective is conceptually and normatively innovative, moving beyond the former thinking in terms of globalization and open economies.

In line with thinking in terms of control points, Dutch innovation policy can, on the one hand, focus on building and strengthening its own control points in order to gain positions of control. On the other hand, Dutch innovation policy can also focus on reducing control points in order to gain control over existing dependencies. The network perspective and the geopolitical perspective in particular provide scope for new forms of innovation policy in light of control points. To offer a policy perspective on this, we therefore conclude this study by identifying areas where control points intersect with Dutch innovation policy and providing examples of possible policy interventions.

## **Getting a grip on control points**

The new government program acknowledges that the Netherlands' future earning capacity is under pressure and that the productivity of the economy must increase if we want to maintain the same level of prosperity (Rijksoverheid, 2024). The objective is therefore for the Netherlands to spend 3% of its GDP on public and private R&D investments by 2030, with the promotion of control points contributing directly to this objective.

In light of this literature review, examples of ways to intensify R&D by establishing control points in the Netherlands include: retaining and attracting innovative multinationals, scaling up R&D-intensive SMEs, start-ups, and scale-ups (business perspective), strengthening specific innovation ecosystems and the application and scaling up of knowledge and technology in value chains (network perspective) and/or strengthening the business climate in the Netherlands by creating space for new players and preventing dependence on R&D from outside the Netherlands (geopolitical perspective).

For example, a significant difference in domestic private R&D expenditure can be made by attracting unique R&D activities of multinationals to the Netherlands and thereby acquiring a control point. There is a large difference in the R&D investments of firms; the largest R&D investors invest a multiple compared to other firms (JRC, 2023).<sup>14</sup> Control points can also be built up more independently by focusing on scaling up Dutch R&D-intensive SMEs and start-ups. This could include specific scale-up policies or proverbial ‘mega field labs’; test locations where firms and knowledge institutions can develop and scale up technologies in practice.

### **Getting a grip on the control points of the future**

The Netherlands' future earning capacity is also under pressure from technological developments and societal challenges. The government's role here is to focus strategically on new value chains and to invest in innovations that drive transitions. The policy implications of this are to stimulate activity in specific sectors and chains (specific innovation policy).

Given that control points have the capacity to both develop and scale up (transformative) innovations, it is also important from a policy perspective to focus on establishing and dismantling control points. In this context, dismantling specifically focuses on discouraging business activities that hinder innovation processes and/or transitions. This can be achieved, for example, through new competition instruments, subsidy and tax reforms, or sustainability and transparency requirements for firms.

When establishing control points in new chains, it is important to build on the activities in which the Netherlands already specializes. This idea has long been the basis of national innovation policy, such as the (mission-driven) top sector policy. It is also in line with the ‘product spaces’ of Hildago and Hausmann (2007; 2009; 2013), who advise diversifying into industries that make use of accumulated complex, productive knowledge. Tomorrow's control points are therefore an extension of today's capabilities.

The National Technology Strategy (NTS), National Growth Fund Programs, and the Netherlands' growth market strategy offer concrete points of contact with the development of control points for the future. The NTS prioritizes ten key technologies that are of strategic importance to the Netherlands' international competitive position (EZK, 2024), with the growth markets focusing on growing sectors in which the Netherlands excels (Dialogic, 2023). The National Growth Fund Programs also support the development and upscaling of technologies in various domains, from quantum and photonics to bio- and agritech. In order to acquire and maintain leading positions in these areas, it is necessary to focus on realizing unique business activities that can fulfill these positions in the chain. This requires not only generic but also specific innovation policy with a focus on stimulating activity within the identified value chains. In addition, the Netherlands currently lags behind in (private) investment in R&D and upscaling, the realization of activity through valorization, and the training of technical personnel (EZK, 2024). Policy interventions to stimulate specific economic activity include, for example, additional tax incentives for R&D or targeted talent, valorization, and upscaling programs.

Finally, the new government program endorses the importance of economic resilience and security. In order to mitigate current – and increasing – external dependencies and threats, it is therefore necessary for us to “carry economic weight on the world market” and build “strong positions in high-value chains” (Rijksoverheid, 2024, p. 117). From a public interest

<sup>14</sup> In the Netherlands, ASML invested €2.8 billion in R&D in 2023, followed by Philips with €700 million. This shows that there are also major differences in the R&D investments of Dutch firms. See also TW, TNO & VNO-NCW (2024).

perspective that extends beyond economic earning capacity, risky dependencies on foreign control points can be reduced by building up our own control points in chains. Examples include the production of energy technologies, the provision of digital services and systems, or the extraction, processing, and recycling of critical raw materials. Existing control points – and the vital infrastructure, technology, and knowledge that underpin them – can also be protected from outside influences by means of regulations on foreign investment (such as the Dutch 'Vifo' Act). Finally, risky dependencies can be proactively reduced through additional (European) policies aimed at, for example, tighter market regulation or import and export levies.

### **Future research**

Establishing and dismantling control points, and designing concrete policy interventions to facilitate this, requires strategic insight into which current (chain) activities are undesirable or risky, on the one hand, and into which chain components the Netherlands can realize unique business activities based on its specialism, on the other. It is also important to learn from the control points we already have and on which we are heavily dependent. Although this report cites examples of possible control points to support thinking in terms of control points, these examples are illustrative and not based on a broad analysis of the Netherlands' current control points. Furthermore, these examples do not necessarily say anything about possible control points in the future.

Further research is therefore needed to put the concept of control points into practice. The scope of this further research is shown in the matrix below (see Figure 7.1). Current control points in the Netherlands (top left) and abroad (bottom left) must be identified, as must the opportunities (top right) and vulnerabilities (bottom left) of possible future control points; after all, it is necessary to determine which control points in the Netherlands can be identified and how they can be supported. An appropriate and substantiated strategic evidence base is needed to support a robust control point strategy that can be used to legitimize policy interventions. This evidence base is not only based on traditional innovation metrics, such as patents, publications, or economic activity, but also on a mix of potentially new indicators, such as links between technologies, the knowledge or business strengths of other countries, or dependence on raw materials. This requires an analytical framework, advanced technological monitoring, and greater awareness of how these dependencies can be reduced. In addition, qualitative insights can also be used, such as the complexity of value chains and the relationship with innovation ecosystems.

Such qualitative insights can answer the question of which assets, competencies, governance, or activities are important for supporting firms and ecosystems that strive for control points, and which policy instruments can be used to achieve such control points. Case studies can contribute to recognizing control points, exploring how they arise, how they are maintained, and their consequences.

The various steps for follow-up research thus offer both insight and a perspective for action for innovation policy around control points. This allows R&D and innovation policy to focus on the Netherlands' greatest opportunities and vulnerabilities in a geopolitically uncertain context.

	Now	Future
Netherlands	Control point	Potential control point
Foreign countries	Strategic dependency (chokepoint)	Risk on dependency (chokepoint)

Figure 7.1: Matrix for future control point research

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