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Review

Conceptualization of Supplier Involvement in Product Development Based on a Systematic Review of 47 Definitions

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Abstract: *Background*: Supplier involvement in product development has proven beneficial for companies and is a phenomenon researched in various domains. The definitions of supplier involvement represent points of origin and dimensions addressed in research. Still, there is no overview of these definitions and dimensions. This study reviews current definitions of the phenomenon of supplier involvement in product development and develops a conceptual model outlining its main dimensions. *Methods*: A systematic literature review is conducted to provide an overview of explicit definitions of supplier involvement in product development. By identifying the elements of these definitions, a conceptual model is developed to demonstrate how the phenomenon has been conceptualized in literature. *Results*: The results include an overview of 47 explicit definitions of supplier involvement in product development, a conceptual model including the identified dimensions, research gaps, and questions for future research. *Conclusions*: Supplier involvement in product development is a complex phenomenon with interdependencies between its key dimensions. A conceptual model of supplier involvement is presented, which is useful for categorizing research to identify research gaps and avenues for future research.

Keywords: supplier involvement; supplier collaboration; supplier integration; product development; NPD; systematic literature review

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1. Introduction

Supplier involvement in product development has brought significant benefits to many companies and has attracted interest from researchers since the 1980s, resulting in publications in different literature domains [1]. Examples of the literature domains include innovation management and new product development, e.g., [2], R&D and technology management, e.g., [3], industrial marketing management, e.g., [4], and purchasing and supply chain management, e.g., [5,6]. Additionally, the phenomenon of supplier involvement in product development has been studied from different theoretical perspectives, including the knowledge-based view, e.g., [7], relational view, e.g., [8], and resource-based view, e.g., [2]. This variety of perspectives across different literature domains can lead to a blurred concept [9]. Various definitions of supplier involvement in product development have been proposed [10]. These definitions describe the essence of the phenomenon and how researchers have perceived it in the world around us. They also show what researchers intended to study and what was considered important in each respective study [11]. Some studies assert that supplier involvement in product development is about managing activities, e.g., [12], while others focus on the resources provided by the supplier, e.g., [13]. Some researchers have narrowed the definition to sharing responsibilities for product development activities, e.g., [14], and others define it more broadly. For example, supplier involvement in product development concerns the integration of resources, the tasks suppliers carry out, and the responsibilities, e.g., [1].

A phenomenon with multiple understandings can end up in a deadlock due to conceptual disagreements, but further theoretical development, starting with providing an overview of the phenomenon, can prevent this from happening [9]. However, the literature lacks an overview of how supplier involvement in product development has been conceptualized. Such an overview would provide a better understanding of how the field has already been researched and a broader understanding of the phenomenon. Identifying and organizing dimensions included in the definitions of supplier involvement into a conceptual model opens opportunities for analyzing research to date. Such a model is useful as an analytical lens for reviewing findings related to the specific dimensions and their interdependencies, identifying research gaps, and providing direction for future research. Following this argument, this article has three objectives. First, it aims to provide an overview and scrutinize definitions of supplier involvement in product development used in previous research. Second, this study develops a conceptual model that outlines the main dimensions of the phenomenon that can be extracted from the definitions. Third, we propose questions for future research with support from the conceptual model.

This paper is based on a systematic literature review (SLR) that provides an overview of explicit definitions of supplier involvement in product development. By identifying the elements of the identified definitions and organizing the elements into dimensions, a conceptual model is developed. The model highlights the phenomenon's complexity by identifying seven interdependent dimensions.

The remainder of the paper is structured as follows: Section 2 describes the research method. Then, Section 3 presents an overview of the identified definitions. Section 4 presents a synthesized view of supplier involvement in product development definitions. Section 5 presents the conceptual model of supplier involvement in product development. Section 6 presents future research directions. Lastly, Section 7 presents conclusions, theoretical and managerial implications, limitations, and avenues for future research.

2. Method

The overall research design involved two phases: (1) a SLR to identify explicit definitions and (2) a content analysis to identify the core elements included in the definitions. A synthesized view of supplier involvement in product development was formed by organizing the identified elements according to the interrogative words why, what, when, and how (WH-questions). These WH-questions helped us understand the origins and main dimensions of the phenomenon. For example, questions such as: why, what, when, and how do customers involve suppliers in product development, were answered.

2.1. Phase 1: The Systematic Literature Review

The SLR was performed in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines [15] and the PRISMA 2020 checklist presented in Table S1. The SLR followed the method presented by Xiao and Watson [16], which included three stages: (1) planning the review, (2) conducting the review, and (3) reporting on the review. The planning stage involved formulating the research objective and preparing the review protocol, including defining inclusion and exclusion criteria, search strategies, screening, data extraction, and synthesis (ibid.).

The second stage, conducting the review, began with the literature search. The search term "supplier involvement" was combined with various terms associated with product development using Boolean operators, see Figure 1.

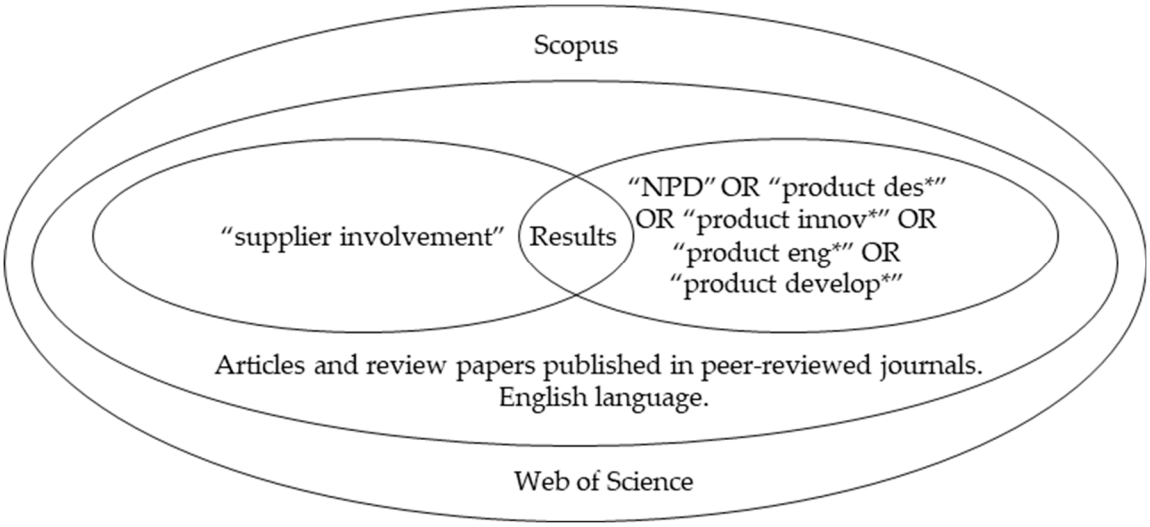

Figure 1. Illustration of the search strategy for the systematic literature review. "*" represents wildcards for any number of characters.

The emphasis on "supplier involvement", while excluding terms such as "supplier collaboration", "supplier integration", and "supplier coordination", was driven by two main factors. Firstly, "supplier involvement" served as an umbrella concept encapsulating all the other terms. Secondly, the term "supplier involvement" was initially introduced in early studies of the phenomenon; for example, the studies by Takeuchi and Nonaka [17] and Clark [18]. Scopus and Web of Science were used to search for peer-reviewed journal publications as they cover research from multidisciplinary fields and provide accessible search functions. The search was limited to English-language journal articles, including review studies, and covered the period up to 29 July 2024.

The search produced 570 articles, as shown in Figure 2, of which 264 were from Scopus and 306 were from Web of Science. After duplicate articles (185) were removed, 385 remained. In the next step, the screening of titles and abstracts, articles that did not mention "supplier involvement" in the context of product development or the related areas of design, engineering, or innovation were removed. This resulted in an additional 154 articles being excluded. For four articles, the full text could not be found. The remaining 227 articles were reviewed to identify whether they included explicit definitions of supplier involvement in product development. This was completed by a text search for "involve*" in the pdf files of the articles. In some of the articles, abbreviations for supplier involvement were used, such as "SI", so the search term was adjusted accordingly. The study of the 227 articles revealed that 170 had no explicit definitions, resulting in 57 remaining articles. However, ten articles were removed because they included definitions of the phenomenon by citing another source, or authors had published almost identical definitions in two publications in the same year. The final set included 47 articles with explicit and unambiguous definitions, and these were included in the analysis.

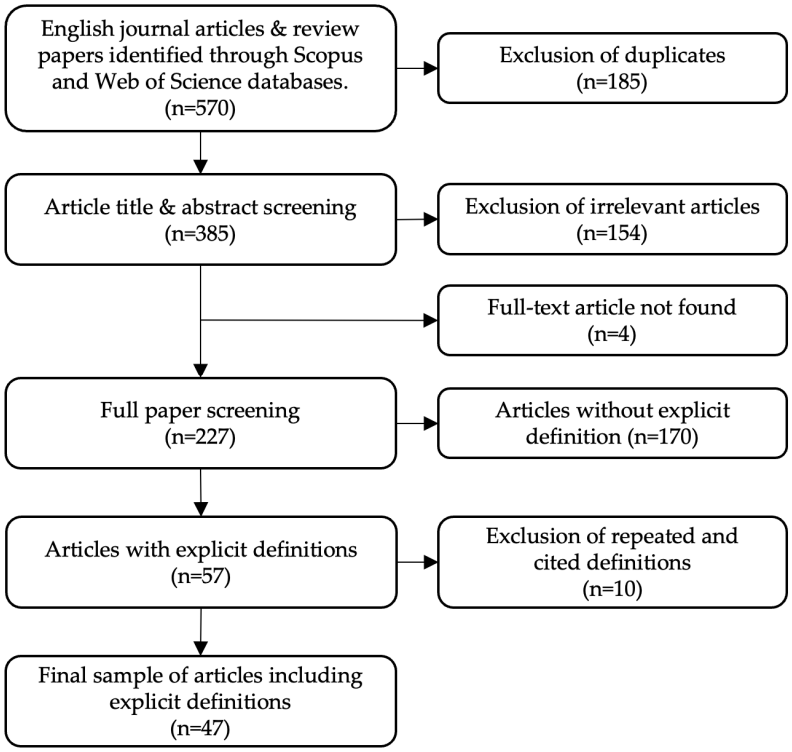

Figure 2. SLR flow diagram based on the PRISMA method.

2.2. Phase 2: Content Analysis

The definitions were analyzed in three steps. First, in vivo coding [19] was used to identify the elements of the phenomenon. Second, the elements that had commonalities were clustered into sub-dimensions [20] and structured following the method previously used by Gioia et al. [21]. For example, the elements of "improved NPD success", "better efficiency", and "enhance performance of new products" were aggregated into the dimension of "Product development performance". Third, the linkages between the dimensions were identified by answering the why, what, when, and how questions. The first author created provisional elements and structures. All authors reviewed these by revisiting the definitions and discussing alternative interpretations of the elements and structures. On the few occasions a disagreement occurred, they were first assessed individually and then the classification was discussed until a consensus was reached. The analysis process included multiple iterations to identify the dimensions and their linkages to then compare them with the theoretical values.

3. Results of the Literature Review

Table 1 lists the 47 explicit definitions of supplier involvement in product development identified in the reviewed articles. The articles were published across a total of 33 different journals, which implies that this phenomenon has been addressed by scholars from different scientific domains. A complete list of journals can be found in Appendix A, Table A1. Many definitions begin with "Supplier involvement refers to…" or similar, which has been excluded from Table 1.

Table 1. List of definitions of supplier involvement in product development (in order of publication year).

Reference	Definition
[22] (p. 49)	"a form of vertical co-operation in which manufacturers involve suppliers at an early stage in the product development/innovation process, generally at the level of concept and design"
[23] (p. 1967)	"the early involvement of preferred suppliers in the buyer's design and development process with regard to part/product development, a product's cost and time to market, material development and selection, and supplier relationships"
[24] (p. 174)	"cooperation between component suppliers and original equipment manufacturers beginning at the product conceptualization stage"
[25] (p. 723)	"the extent a supplier contributes to NPD of a focal customer from the idea stage to the prototype testing stage"
[14] (p. 531)	"the extent to which a buyer organization shares responsibility with a supplier organization for the development and design of the subsystems (or components) of a new product"
[26] (p. 45)	"a form of collaboration in which purchasing firms involve suppliers at an early stage in the life cycle of a product, generally at the time of product concept or design"
[27] (p. 182)	"the extent of suppliers' direct involvement in the product development activities. The extent of supplier involvement can be determined by the frequency of design-related communications between the suppliers and NPD team [. . .] *, and the extent to which suppliers have their influence in the decision-making of product design"
[4] (p. 937)	"the combination of the buyer's and supplier's R&D resources and the exploitation of joint capabilities through strategic integration of the buyer–supplier relationship"
[28] (p. 903)	"entails involving suppliers in the product development phases for the buying firms' new products and/or in redesigning the existing products of the buying firm"
[29] (p. 307)	"the extent to which supplier involves in new product development activities and decision-making"
[30] (p. 914)	"Partnerships are forged with suppliers to take advantage of their technological expertise in design and manufacturing"
[2] (p. 182)	"the resources (capabilities, investments, information, knowledge, ideas) that suppliers provide, the tasks they carry out and the responsibilities they assume regarding the development of a part, process or service for the benefit of a buyer's current or future product development projects"
[1] (p. 187)	"fundamentally it concerns the integration of the capabilities that suppliers can contribute to NPD projects [. . .], the tasks they are able to carry out on behalf of the customer, and the reponsibilities they assume for the development of a part, process or service"
[31] (p. 191)	"Appropriate responsibility given to supplier during the NPD process and improve NPD success by sharing cost and technology information and innovation capability"
[32] (p. 856)	"occurs when a customer involves its supplier at the early phase into NPD process"
[33] (p. 78)	"a form of vertical cooperation in which manufacturers involve suppliers at an early stage in the NPD process"
[34] (p. 84)	"the combination of the purchasing firm's and the supplier's R&D resources and the exploitation of joint capabilities through the strategic relationship"
[35] (p. 235)	"the supplier resources, tasks and responsibilities provided at all NPD stages of a focal customer, from the idea stage to the prototype building and pilot testing stage"
[36] (p. 1261)	"a buyer's decision to involve a supplier "from the outset and through successive stages" of its new product development process"
[37] (p. 193)	"involving major supplier in the product development process to achieve improved NPD performance"
[13] (p. 3860)	"suppliers providing firms with resources and taking the relevant responsibilities"
[38] (p. 3388)	"the utilisation of joint capabilities stemming from the strategic integration of buyer–supplier relationship and combination of buyer's and supplier's R&D"

Table 1. *Cont.*

Reference	Definition
[39] (p. 102)	"the extent to which a supplier is involved in codesigning and new product development processes with their customers in exchange relationships"
[40] (p. 315)	"supplier input in the design phase of new product development that results in better information, technology, and efficiency"
[41] (p. 112)	"the integration of suppliers' capabilities into NPD projects [. . .], the tasks they are able to carry out on behalf of the customer, and the responsibilities they assume for the development of a part, process or service"
[42] (p. 275)	"the resources provided by suppliers—for instance, capabilities, information and knowledge—as well as the tasks suppliers carry out and their responsibilities in the development of a part, process or service for the buying company's current or upcoming product development projects"
[43] (p. 163)	"the responsibility suppliers assume, the activities they perform and the resources they supply, all of which are influenced by the task they are asked to carry out"
[44] (p. 173)	"the extent to which manufacturers incorporate their suppliers into product development and continuous improvement programs"
[45] (p. 1750059-13)	"the extent to which design and development related responsibilities of the subsystems (or components) of a new product are shared with suppliers"
[46] (p. 806)	"the dependence of manufactures on suppliers for engineering work to reduce the former's internal engineering efforts"
[47] (p. 172)	"the extent to which a supplier is involved in its manufacturers' NPD process by providing knowledge resources and participating in decision-making during the development of new products"
[48] (p. 1850004-4)	"the relative degree of participation that suppliers have in a firm's NPD process. Supplier involvement in NPD is the integration of capabilities, investments, information, knowledge that suppliers provide"
[5] (p. 2)	"the integration of the capabilities that suppliers can contribute to NPD projects [. . .], the tasks they are able to carry out on behalf of the customer, and the responsibilities they assume for the development of a part, process or service"
[10] (p. 33)	"The (amount of) participation of suppliers in their customer's innovation projects"
[12] (p. 360)	"it is 'a process of managing the involvement of suppliers in the development of (new) products/services/processes/technologies for the chosen category'"
[49] (p. 521)	"the strategic joint collaboration between the supplier and manufacturer in planning and product development"
[50] (p. 3)	"the incorporation of technologies, technical information, ideas and the development of tasks in order to enhance the performance of new products"
[51] (p. 3)	"the extent to which activities are conducted jointly with the supplier during the five stages (i.e., from the idea generation stage to the prototype development stage) of an NPD project aimed at developing an environmentally friendly product.
[52] (p. 976)	"a situation in which a customer integrates a supplier within their R&D area, especially in designing new products or redesigning the customer's existing products [. . .]. This practice entails giving the supplier some responsibility in the NPD process"
[53] (p. 161)	"the integration of the capabilities that suppliers can contribute to new product development projects, the tasks they are able to carry out on behalf of the customer and the responsibility they assume for the development of a part, process or service"
[54] (p. 145)	"the extent to which suppliers are directly involved in the focal firm's new product development, coordinates interfirm activities related to the product, process and supply chain design"
[55] (p. 143)	"the integration of the supplier's resources and capabilities, as well as the tasks and responsibilities it assumes for developing a component on behalf of the customer"
[56] (p. 1)	"a supplier's participation in the early stages of the buyer's new product development (NPD) to contribute to the buyer's NPD success"
[57] (p. 799)	"the responsibility suppliers assume, the activities they perform, and the resources they supply, all of which are influenced by the task they are asked to carry out"

Table 1. *Cont.*

Reference	Definition
[58] (p. 5)	"the extent a supplier is involved in the NPD process with its buyers"
[59] (p. 671)	"the resources (capabilities, investments, knowledge, etc.) that suppliers can provide and the responsibilities they hold regarding the design and development of an NPD"
[60] (p. 236)	"the supplier's participation in various stages of product development based on a partnership, extensive communication and the long-term perspective of cooperation"

* References used in definitions.

4. Elements and Dimensions Addressed in the Reviewed Definitions

In the content analysis, several elements addressed in the definitions of supplier involvement in product development were extracted. These elements were clustered into seven main dimensions, each associated with the interrogative words why, what, when, or how. The following is a brief description of the seven dimensions. Table 2 depicts a synthesized view of all the identified elements, dimensions, and the WH-questions.

Table 2. Overview of the identified elements with references to the definitions, dimensions, and the four WH-questions.

Elements and References to Definitions	Dimensions	WH-Questions
Improve NPD success [31]; improved NPD performance [37]; better information [40]; better technology [40]; better efficiency [40]; reduce engineering efforts [46]; enhance performance of new products [50]; NPD success [56].	Product development performance	Why?
Resources [2,4,34,35,37,42,43,47,55,57,59]; capabilities [1,2,4,5,34,38,41,42,48,53,55,59]; investments [2,48,59]; information [2,42,48,50]; knowledge [2,42,47,48,59]; ideas [2,50]; technologies [50]; technological expertise [30].	Leveraging resources and capabilities	
Sub-system [14,45]; component [14,45,55]; product [14,23,27,28,45,47,49–52,54]; part [1,2,5,23,41,42,53]; process [1,2,5,41,42,49,51,53,54]; service [1,2,5,41,42,49,53]; technology [12].	Entity of development	What?
Development [1,2,14,23,41,42,44,45,47,49,51,53,55,59]; design [14,45,52,59]; activities [27,43,51,54,57]; re-design [28,52]; codesign [39]; continuous improvement [44]; engineering work [46]; planning [49].	Type of development	
All NPD stages [35]; various stages [60]; idea stage [25,35,51]; outset of new product development process [35]; early stage [22,26,32,33,56]; product conceptualization stage [24]; level of concept and design [22,26]; design phase [40]; prototype testing [25]; pilot testing stage [35]; prototype development [51].	Moment of involvement	When?
Task [1,2,5,35,41–43,50,53,55,57]; responsibility [1,2,5,14,31,35,37,41–43,45,52,53,55,57,59].	Division of tasks and responsibilities	How?
Cooperation [22,24,33,60]; integration [1,5,41,48,53,55]; utilization [38]; sharing [31]; combination [4]; incorporation [50]; collaboration [26,49]; partnership [30,60]; influence [27], involve [22,23,26,28,32,33,58]; involvement in product development activities [27], participating in decision-making [47]; participating in product development [10,48,56,60]; jointly activities [51]; coordinating activities [54]; communication [27,60]; sharing information [31].	Integration	

Sixteen elements were clustered into two dimensions that relate to the "why" suppliers and were involved in product development: 'Product development performance' and benefit from 'Leveraging supplier resources and capabilities'. The definitions mention various product development performance improvements such as 'better information' [40],

'reduced engineering efforts' [46], and 'enhance performance of new products' [50]. Regarding resources and capabilities, which are among the more common elements, some definitions also included specific examples of resources, such as access to 'knowledge' [2] and 'technologies' [50].

Fifteen elements were clustered into the dimensions of 'Entity of development' and 'Type of development'. These dimensions refer to "what" tasks are performed by the suppliers. Examples of different elements in the entity dimension include 'component', e.g., [14], 'subsystem', e.g., [45], 'technology' [12], 'process', e.g., [41], or a 'service' [42]. Examples of different types of development that suppliers carry out include 're-design' [28,52], 'continuous improvement' [44], 'engineering work' [46], and 'development' [23].

The dimension 'Moment of involvement' refers to "when" suppliers are involved in product development. The eleven elements in this dimension specify key stages in the product development process, such as the 'idea stage', e.g., [25], the 'design phase' [40], and 'prototype testing' [25].

Nineteen elements constitute the dimensions 'Division of tasks and responsibilities' and 'Integration', which relates to "how" involvement is set up or carried out. Several definitions include the elements of 'task' and 'responsibility' assumed by the supplier, e.g., [1,2,14]. Examples of elements connected to integration are: 'cooperation', e.g., [24], 'sharing' [31], 'incorporation' [50], 'collaboration', e.g., [26] 'coordinating activities' [54], 'participating in decision-making' [47], and 'Communication' [27].

An all-encompassing definition was not found; no definition included all dimensions or elements from all WH-questions. The most frequent element was 'responsibility', which occurred in 16 definitions. Other common elements included 'development' (13 definitions), 'task' (12 definitions), 'capabilities' (11 definitions), 'resources' (10 definitions), and 'product' (10 definitions). This reflects how several definitions describe supplier involvement as the supplier being given the task and responsibility to develop a product. Several definitions also highlighted the resources and capabilities, with most of the definitions adopting a customer perspective regarding these two elements. For example, the definitions described the purpose of the involvement in terms of only the customer's benefit, such as the customer taking advantage of the supplier's resources, e.g., [1,2,13,40,42,47,53]. A few definitions had a dual perspective, describing the phenomenon as a combination of the customer's and the supplier's resources and capabilities, e.g., [4,34,38]. The identified definitions reveal a clear bias, as supplier involvement in product development is predominantly viewed from the customer's perspective. None of these definitions adequately captured the supplier's viewpoint suggesting that research has largely overlooked the challenges and opportunities suppliers face when participating in customers' product development processes [55,61].

Analyzing the definitions over time indicated that this bias has persisted, with little evolution in how supplier involvement is conceptualized. Both recent and early definitions continue to emphasize the customer's perspective. This focus is understandable to some extent, as supplier involvement inherently involves customers leveraging their suppliers' resources and capabilities to enhance product development outcomes. However, given studies [62,63] that highlight the importance of trust and long-term relationships for successful supplier involvement, it is surprising that more definitions do not explicitly address the supplier's perspective.

By reviewing the definitions, it is also apparent that the integration dimension includes the greatest number of elements, which shows that the terminology used for this dimension is diverse and focuses on different types of interrelationships between customers and suppliers. This, however, reflects prior studies that indicate the presence of a wide variety of interrelationships ranging from "close to distant" involvement of suppliers in product development activities. For example, Petersen et al. [64] identify three distinct types of supplier involvement: white box, grey box, and black box, each representing varying levels of involvement and corresponding responsibilities for the supplier.

5. A Conceptual Model of Supplier Involvement in Product Development

Based on the analysis of the identified definitions, a conceptual model of supplier involvement in product development is devised in Figure 3. It originates from the seven dimensions outlined in Table 2. The model elaborates on the dimensions, where each dimension is further detailed, and their interrelationships are also discussed.

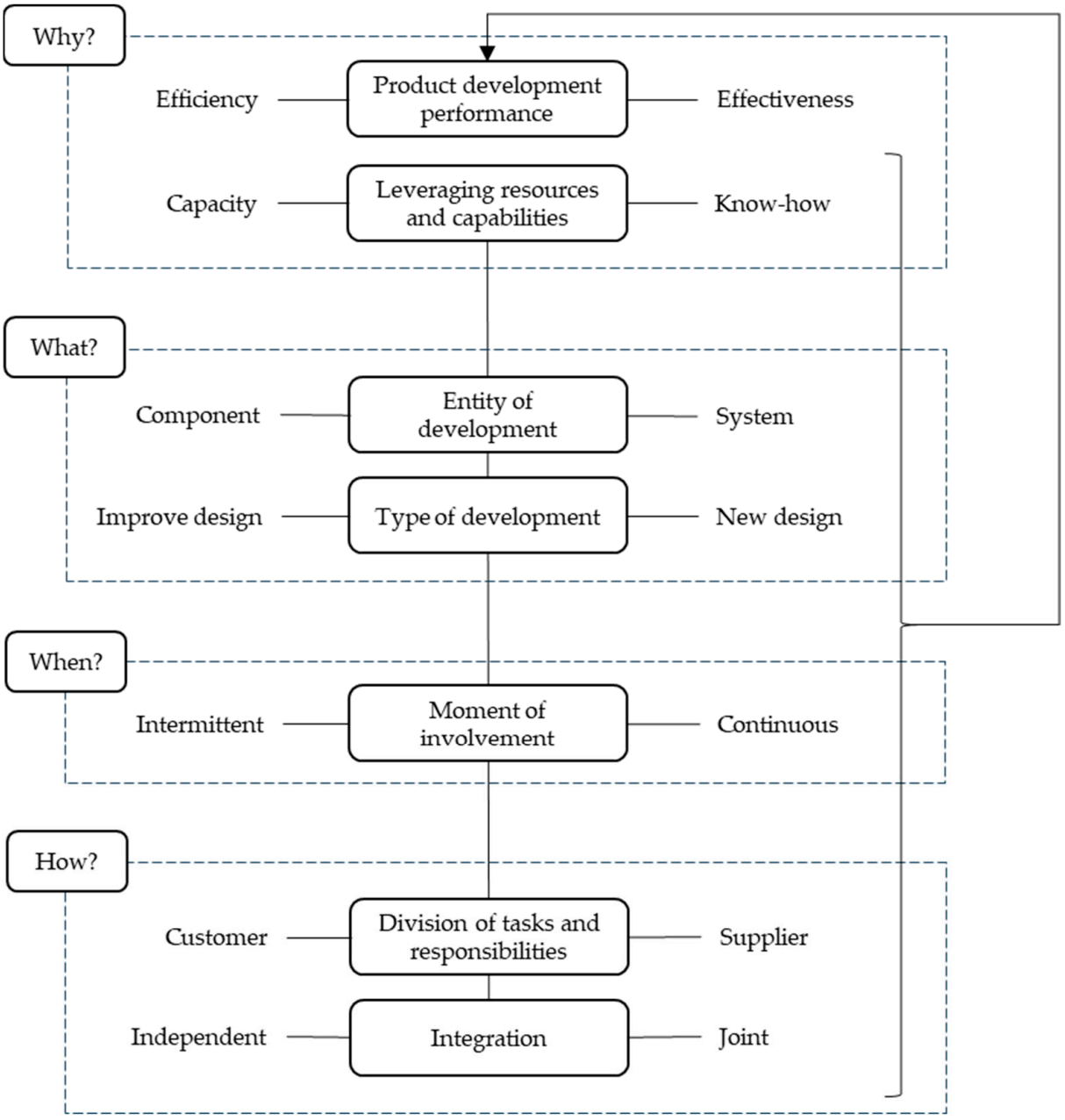

Figure 3. A conceptual model illustrating how supplier involvement in product development has been conceptualized in literature.

Two of the dimensions refer to the purpose (why) of involving suppliers in product development: 'Product development performance' and 'Leveraging resources and capabilities'. The first dimension, 'Product development performance', represents the anticipated outcome from the other dimensions and the benefits associated with its involvement. The outcomes can be categorized into two types, those related to the development process (efficiency) and those related to the developed product (effectiveness). Efficiency refers to adherence to project targets and utilization of fewer resources, while effectiveness refers

to the resulting product's quality and performance in the market [10]. In addition to the outcomes mentioned in the definitions, previous research has also highlighted that supplier involvement in product development can improve performance in multiple ways, for example, by reducing development costs and increasing product quality [14]. However, according to a meta-study by Suurmond et al. [10], empirical research to date shows an inconsistent picture of the benefits of supplier involvement. The second dimension, 'Leveraging resources and capabilities', refers to all the provided resources and capabilities supplementing the customer. There are two primary motives. The first motive is to get access to 'know-how'. For example, to gain access to critical technical knowledge that complements the customer's existing resources. The second motive is to increase the product development capacity or flexibility [65].

Two other dimensions address the tasks (what) assigned to the suppliers: 'Entity of development' and 'Type of development'. The 'Entity of development' represents the main deliverable. The complexity of the entity, referring to the number of components and interfaces, varies. In general, fewer interfaces need to be considered when developing a component compared to a system. The 'Type of development' relates to whether the task involves improving an existing design or developing a new one. 'Improve design' refers to when the design relies on known solutions. For example, when parts and subassemblies are designed by modular products, re-designing, or adapting existing products. New design refers to when design activities rely on new solutions and developing new technology, which entails a higher degree of uncertainty [66].

One dimension, 'Moment of involvement', refers to when suppliers are actively involved in development, ranging from the beginning to the end stages [67]. In some cases, the supplier is involved continuously throughout the project, but the involvement can also be intermittent. For example, the supplier is only involved in a specific phase or on an ad hoc basis [3]. Suppliers are most commonly involved during the early stages of the development process. However, their involvement can be as late as the prototype stage [68].

Two dimensions relate to the management (how) of the interdependencies between the customer and the supplier, and the division of tasks: 'Division of tasks and responsibilities' and 'Integration'. 'Division of tasks and responsibilities' refers to the extent to which the development is customer or supplier-driven. Several frameworks of supplier responsibility have been presented, but in essence, they describe whether the supplier is consulted on the customer's design when the design is customer-driven, if it is a shared responsibility, or if it is primarily driven by the supplier [64,69]. 'Integration' refers to the process of achieving the required unity of effort for the task [70]. The extent of integration can vary between whether the development is executed independently or jointly.

The seven dimensions display interdependencies. The definitions show that all dimensions are important for achieving product development performance. For example, having a clear 'Division of tasks and responsibilities' between the customer and supplier is related to a shorter time to market and improved product quality [1,45]. Another example, regarding the 'Moment of involvement', indicated that the involvement of suppliers at an early stage of the product development process can reduce engineering changes, which will reduce lead time and cost [38]. A third example related to the Leveraging resources and capabilities dimension has shown that the capabilities of the project leader [71] and the supplier's salesperson's ability to set clear targets and goals together with the engineers [56] are important for 'Product development performance'.

Interdependencies also exist between the other dimensions. For example, the 'Type of development' drives the 'Moment of involvement'. When a customer is dependent on the supplier's development of new designs, earlier and more continuous involvement is necessary [72]. Another example refers to the interdependencies between the Entity of development, 'Type of development', and 'Integration'. Involving suppliers in system development and new design requires the actors to work closely together [73]. This is also the case when customers have long-term learning intentions and want to leverage the supplier's know-how [3].

6. Future Research Directions

This study shows that a majority of the definitions adopt a customer perspective and none describe supplier involvement in product development from the supplier's perspective. This is consistent with an earlier literature review by Johnsen [1], showing that research has predominantly adopted a customer perspective for supplier involvement. The SLR presented in this study also indicates that research still has a strong customer bias regarding supplier involvement in product development, even 15 years later. Consequently, there is a need for a deeper understanding of the supplier's perspective as argued by Flankegård et al. [61]. The literature review, summarized in the conceptual model, provides the basis for further research suggestions. Additional research into supplier involvement in product development should incorporate the supplier's perspective more explicitly and address the dimensions outlined in the conceptual model. Table 3 presents suggestions for future research categorized according to the interrogative words. The conceptual model presented in Figure 3 can also be used when studying the research questions as an analytical lens when categorizing and sub-summing data from the studies into patterns.

Table 3. Future research directions for supplier involvement in product development.

Interrogative Words	Questions
Why	• How can suppliers be efficient and effective when involved in several customers product development? • What resources and capabilities are important from a supplier's perspective when involved as a capacity provider in customer's product development? • Which resources and capabilities are important from a supplier's perspective when involved as a know-how provider in customer's product development? • What can suppliers benefit from being involved in customer's product development?
What	• What processes should suppliers have implemented when involved in customer's component or systems design? • What competencies do suppliers need when involved in customer's development of new design? • What product characteristics are important to consider from a supplier's perspective when involved in customer's product development?
When	• What factors are important from a supplier perspective when deciding the moment of involvement? • What are the challenges from a supplier's perspective when involved intermittently in customer's product development? • Which product development tasks are prioritized getting involved in early from the supplier's perspective?
How	• What are the main decision factors from the supplier's perspective when deciding on the division of tasks and responsibilities? • What are the integration challenges suppliers' face when involved in customers' product development? • What capabilities are needed for suppliers to overcome the challenges of integration when involved in customers' product development? • What are the drivers for integration from the supplier's perspective? • Is there a difference in the level of required integration depending on whether the customer or the supplier is responsible for the development? • Is there a difference in the level of required integration across customer-supplier interfaces for suppliers when involved in customer's product development?

7. Conclusions

This SLR focused on definitions of supplier involvement in product development outlined in existing literature. The research assessing the phenomenon is extensive, but this study indicates that it is often unclear what has been studied, given that only 57 out of 227 articles included an explicit definition. Consequently, most of the studies have not clearly explained what supplier involvement in product development is about. This study

provides an overview of the explicit definitions that have guided prior research. A major contribution of this study is the distillation of the key dimensions of the phenomenon into a conceptual model (Figure 3), illustrating how supplier involvement in product development has been conceptualized in literature. The model encompasses seven interdependent dimensions: (1) Product development performance, (2) Leveraging resources and capabilities, (3) Entity of development, (4) Type of development, (5) Moment of involvement, (6) Division of tasks and responsibilities, and (7) Integration. From the analysis, it can be concluded that the conceptualization of supplier involvement in product development encompasses diverse yet interdependent dimensions. The diversity of definitions and included elements shows the variety of topics researched but also indicates a lack of conformity around the concept's meaning. This suggests that it is a complex phenomenon, both as a research topic and as an industrial practice.

7.1. Theoretical Implications

The conceptual model can support researchers in taking a deeper look into the extensive research on supplier involvement in product development. It can be used as a lens to categorize this research and to identify potential research biases and gaps in knowledge. For example, it could be of interest to know if any of the identified dimensions, or a set of dimensions, have received more attention than the others when prioritizing future research.

7.2. Managerial Implications

The results of this study also have important implications for managers. The conceptual model demonstrates the phenomenon's complexity and offers managers a comprehensive overview of the various dimensions of supplier involvement in product development. This may assist when prioritizing investment efforts related to the different dimensions but may also contribute to understanding what role dimensions play in achieving fruitful outcomes from involvement. It is worth noting that the model's dimensions are interdependent and all of them must be considered.

7.3. Limitations

As with any SLR, the method's limitations should be considered. This review is limited to its focus on the explicit definitions of supplier involvement in product development found in peer-reviewed articles on Scopus and Web of Science. Other related concepts, such as supplier collaboration, supplier integration, and supplier coordination, were excluded. It is worth noting that the concepts occurred as elements related to the integration dimension of supplier involvement, suggesting some overlap between them. However, further studies are necessary to determine if there are additional dimensions that can be identified by examining the related terms more closely. Based on the definitions, this study proposes a new conceptual model of supplier involvement in product development. However, it is among the first studies of its kind, and further research is necessary to validate the model and its aspects. This presents an opportunity for future research development and improvement.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/logistics8040094/s1, Table S1: PRISMA 2020 Checklist.

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Appendix A. Journal List

Table A1. List of 33 different journals.

Journal	Count	References
Industrial Marketing Management	4	[4,36,41,43]
Journal of Business Research	3	[24,25,56]
Journal of Product Innovation Management	3	[2,39,40]
Journal of Purchasing and Supply Management	3	[1,5,33]
International Journal of Information Systems and Change Management	2	[27,29]
International Journal of Innovation Management	2	[35,45]
International Journal of Production Research	2	[23,38]
Journal of Supply Chain Management	2	[10,26]
Supply Chain Management: An International Journal	2	[47,54]
Central European Management Journal	1	[60]
European Journal of Innovation Management	1	[58]
Industrial Management & Data Systems	1	[37]
Information Technology Journal	1	[13]
International Journal for Quality Research	1	[52]
International Journal of Innovation and Technology Management	1	[48]
International Journal of Internet Manufacturing and Services	1	[44]
International Journal of Management and Enterprise Development	1	[42]
International Journal of Manufacturing Technology and Management	1	[34]
International Journal of Market Research	1	[49]
International Journal of Operations and Production Management	1	[28]
International Journal of Production Economics	1	[51]
International Journal of Technology Management	1	[22]
International Journal of Value Chain Management	1	[50]
Journal of Business and Industrial Marketing	1	[55]
Journal of Intelligent Manufacturing	1	[46]
Journal of Management	1	[14]
Journal of Manufacturing Technology Management	1	[30]
Operations and Supply Chain Management	1	[12]
Operations Management Research	1	[57]
Production Planning and Control	1	[53]
Service Industries Journal	1	[31]
Total Quality Management & Business Excellence	1	[59]
World Academy of Science, Engineering and Technology	1	[32]

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