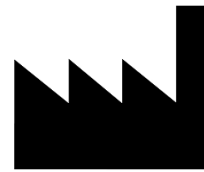


Brabantse Ontwikkelings Maatschappij



Brainport
Industries

Productization of supply companies

Value creation beyond manufacturing services

White Paper

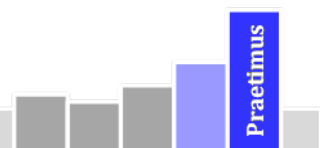
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Productization of supply companies

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Preface

Productization refers to the idea that suppliers deliver whole products or modules to OEMs and strategically integrate their development activities with OEM roadmaps. This White Paper delves into the question to what extent productization occurs in manufacturing industries in the Netherlands. Already twenty years ago the basic ideas behind productization were developed. Application in practice however, remained limited. Few suppliers upgraded their capabilities to enable productization; few OEMs asked for it. Productization largely remained a theoretical idea.

This White Paper illustrates that the theory is now finally turning into practice. Based on research done by Praetimus among frontrunners in high and medium tech sectors, the authors conclude that OEMs as well as suppliers are developing in such a way as to make productization possible. Companies see the necessity to work in this direction and are able to identify the benefits it may bring. When the frontrunners are working towards this, other companies will surely follow over the next few years.

The White Paper however also shows that there is a double gap to be bridged. The first gap lies in the fact that the current demands of OEMs and the capabilities of suppliers do not fully match. Both OEMs and suppliers companies perceive a need for productization, but most of them have not yet reached the maturity level to realize it. The second gap is the discrepancy between their interests and way of working: OEMs seem to apply a long-term business perspective, but often still use a short-term financial approach, whereas suppliers have an operational orientation, with limited business focus. This double gap raises the fundamental question whether the Dutch industry is ready and able to make the next step.

Both OEMs and suppliers have work to do. OEMs can only be successful when they have strong suppliers in their immediate proximity. Suppliers can only be competitive when they are able to meet OEM demand. Fortunately, the Praetimus research also identified a number of best practices that will help companies to close the double gap. The White Paper substantiates the need for new collaborative business models to be implemented to make productization a success. Examples show this is possible, although it is not easy.

The many issues and opportunities identified in this White Paper relate to the core of the competitiveness of the Dutch industry. For that reason it is both logical and commendable that Brabant Development Agency (BOM) and Brainport Industries have recognized this theme. As joint sponsors of this important research study they have taken up the responsibility to create awareness about the challenges the industry in the Netherlands faces in making the transition towards truly 21st century relations between OEMs and suppliers. I am convinced both OEMs and suppliers will benefit considerably from reading this highly informative White Paper.

Ard-Pieter de Man

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Executive Summary

What is productization?

Productization is the transformation process wherein suppliers create value beyond manufacturing services. Value in terms of 'products' (modules up to semi-products) that are funded, developed, delivered and sustained by suppliers and aligned with Original Equipment Manufacturers (OEMs) roadmaps and requirements. These suppliers become virtually integrated build-to-roadmap partners for several OEMs.

Why is productization important?

For over ten years Western OEMs increasingly apply the strategic sourcing concept: they reinforce their focus on core competences and outsource to a much larger extent. Hence they select and orchestrate suppliers that have delivery *and* development capabilities; suppliers that are productized. Productization is therefore important since it enables the success of these OEMs and their surrounding supplier networks and as such determines the strength of a region by close collaboration.

Why did Praetimus initiate this productization research study?

In our consulting practice we have experienced that OEMs in the Netherlands also intent to outsource at a higher level. However, they struggle to find and collaborate with Dutch suppliers that have gone through the productization transformation. Understanding the productization challenges helps us to contribute to the development of Dutch OEMs and their suppliers and ultimately to advance the industry in the Netherlands one step further.

What was the research about?

The key questions of our productization research are:

- ❖ Do value chains develop according to a maturity model over the business life cycle?
- ❖ What are the major drivers and inhibitors to move to a next maturity stage?
- ❖ What are the current and pursued maturity levels, underlying business elements and best practices?

What are the key findings and conclusions?

Our findings and conclusions of the productization research are:

- ❖ In high and medium tech markets outsourcing grows, now more than in the past. Main OEM driver is core competence focus, for suppliers growth, customer lock-in *plus* OEM pressure. Dependency and resistance are the OEMs' major inhibitors; for suppliers lack of value-adding capabilities.
- ❖ To date productization is situational, only a limited number of cases exist in the Netherlands. OEMs are at the semi productization stage, expecting build-to-specifications supply, whereas suppliers are at the ad hoc stage, with a build-to-print plus profile, delivering sub-assemblies and components. This implies an OEM-supplier maturity gap.
- ❖ Moreover there appears to be an OEM-supplier transformation gap: interests conflict and OEMs act strategic, suppliers operational. Consequently the productization transformation can be characterized as the 'hopping procession of Echternach': three steps forward, two steps backward.
- ❖ To avoid that Dutch OEMs set their sights abroad, acceleration is required, starting with:
 - ◇ OEMs: business driven sourcing, directed at value.
 - ◇ Suppliers: focus in profile and business model.
- ❖ The maturity model and best practices support structuring and acceleration of the transformation.

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1. What is Productization?

Spring 2014 the contract with ASML was signed (Link Magazine, 2014). Since then VDL ETG bears complete responsibility for ASML's wafer handler, a precision module in the ultra high tech wafer stepper of the Original Equipment Manufacturer (OEM), the lithographic system that is core in the production process of chips. Completely? Yes, everything: so next to manufacturing, which VDL ETG already did, now the supplier is also accountable for the end-to-end development, including future generations, and servicing of all wafer handlers in-the-field.

The deal should lead to a shorter time-to-market, more innovative and improved wafer handlers and ultimately lower costs for ASML and higher margins for VDL ETG. Apparently a dilemma: the supplier however believes it can reduce the total cost of ownership, that is the full costs of development, production, uptime and end-of-life, because its development and production sit together; with all the advantages in terms of speed and efficiency of that. Furthermore, the supplier will deploy the knowledge and skills it gains from one customer to other customers - not ASML competitors of course -. As the in-house technologies of VDL ETG eventually improve, the company becomes a robust partner and - because development costs are distributed over more customers - the total cost will go down.

ASML

ASML is a developer and integrator of lithography systems, with 5.9 B€ revenues, 20% profit and 14.000 FTE (~30% in development) staff (2014). Traditionally ASML already outsourced at a relatively high level, compared to its more vertically integrated competitors Canon and Nikon. Due to the progressively challenging litho roadmap ASML's outsourcing level is increasing even further: 85% of its bill-of-material comes from suppliers.

For ASML the full outsourcing of the wafer handler is a result of the roll-out of its successful strategic sourcing concept: it concentrates on those technologies, know-how and capabilities that give the company a unique competitive edge and outsources other activities as much as possible (Schuurmans, 1997/1999).

VDL ETG

VDL ETG is a mechatronics integrator with some 400 M€ revenues and 1.800 FTE (~10% in development) staff (2014). It is part of VDL Group, a Dutch family-owned industrial company with nearly hundred subsidiaries and over 10.000 employees. Its strategy is to take on module responsibility over the product life cycle. As such it expands development, engineering and architecture capabilities and implements complete product creation (PCP) and product life cycle management (PLM) processes.

For VDL ETG however it is a relatively new direction, that fits into its aimed for positioning and strategy: not only capable of manufacturing services delivery and high tech components production, but also the (co-)development, engineering, sourcing and assembly thereof. As such the company transforms from build-to-print subcontractor towards at least a build-to-specifications supplier, thus it is 'productizing'.

Productization

Productization is a transformation process wherein suppliers create value beyond manufacturing services, as they:

- ❖ Take a concept, technology or capability.
- ❖ Turn it into fully marketed, developed, designed, industrialized, build, integrated, installed, maintained and sustained 'product' (modules up to semi-products).
- ❖ With own roadmaps and competences.
- ❖ Financed and funded by the supplier.
- ❖ Reuse it for several OEMs.
- ❖ Ultimately have 'life time accountability' for the 'product'.

Productization of supply companies

This definition emphasizes that the fundamental principle of productization is to understand how the customer (or even the customer's customer) will use the 'product' of the supplier in such a way that it increases the value of its proposition. Furthermore this definition illustrates the changing relation between customer and supplier: traditionally the relation between the OEM and the build-to-print supplier was loose and interchangeable. Productization requires both companies to share customer insights, vision on the product and technology roadmap and understand the mutual dependencies and risks. These risks are managed in contracts, but handled in trust.

As one research participant put it: "Only companies that fully understand their own core competences in relation to the core of their partners can move forward in this way".

The importance of productization

ASML's strategic sourcing approach is not unique. These days it is applied in almost all 'low volume, high mix, high complexity' sectors (Brainport Industries 2008/2011; Point.one, 2010). Low volume refers to limited series of only dozens to a few hundred units. High mix concerns a wide variety of to be delivered different products, often customized systems (devices, machines, equipment etc.), based upon product families, platforms and building blocks (functional modules). The demand and supply chain is usually characterized by large fluctuations in volume (half and double). High complexity addresses technological (development and engineering) and logistical (assembly and installation) complexity and regularly requires multidisciplinary capabilities (mechanics, electronics, software, physics etc.), a geographically close chain and a standard development language. Examples are the semiconductor and health tech industry, aerospace and defense, ship and train building and industrial equipment.

In addition to market and technology trends these sectors are subject to the strategic sourcing concept, sometimes called 'functional' or 'higher' outsourcing. This concept implies that OEMs more and more tend to source entire building blocks - sub-assemblies and modules - instead of components only. From OEM perspective the main reason is to achieve more effective supply chain management with fewer direct suppliers. Moreover OEMs not only try to outsource production and assembly but also innovation and involve suppliers in their development and design processes, in such an early stage that creativity, capabilities and capacity of the supplier can be applied: early supplier involvement (ESI). Consequently value creation in the chain is migrating (figure 1).

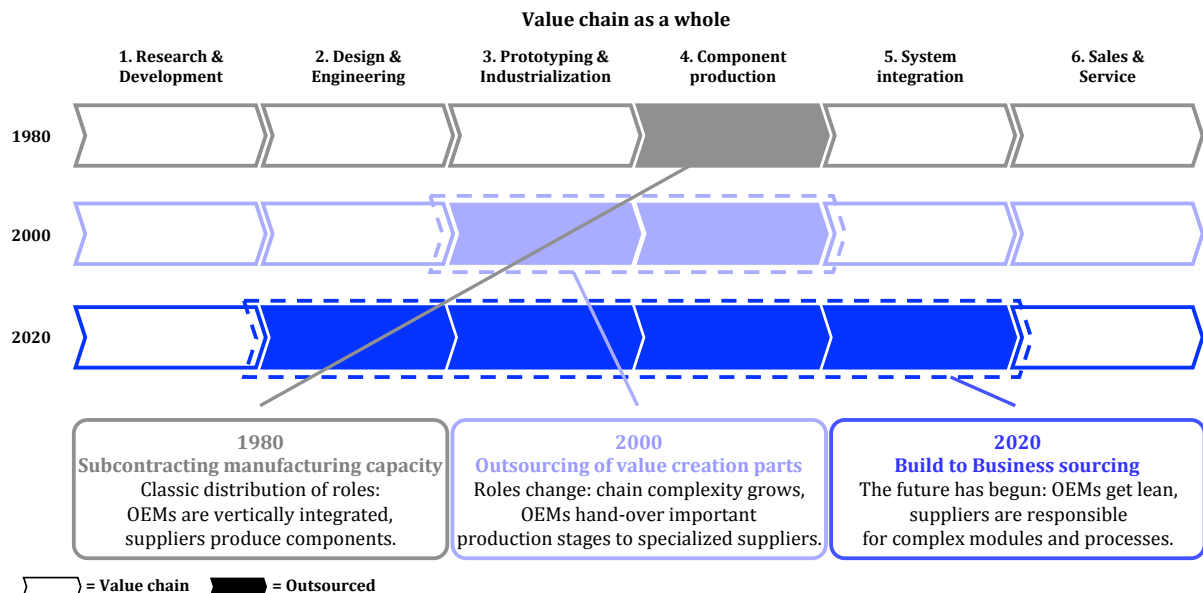


Figure 1: Value creation over time

Productization of supply companies

Already ten years ago it was reported (BusinessWeek, 2005) that Western OEMs - after farming out manufacturing in the '80s and '90s - started outsourcing development in the twentieth century as well. OEMs like Dell, HP and Philips started to buy complete modules of contract manufacturers and design houses like Cellon, Flextronics and Quanta. The electronics industry leads down this road, closely followed by aerospace, pharmaceuticals and food sectors. Main driver is the request for more innovation; OEM development only is not fast and not yielding enough. As a consequence OEMs focus on customer intimacy and next-gen technologies and orchestrate supplier networks, whereas suppliers at their turn should 'move up the development chain'. Overall collaboration in the value chain becomes vital.

Other research (HTSC, 2014-2015) indicated that each chain layer in the semiconductor industry is consolidating: device manufacturers like Intel, Samsung and TSMC, equipment OEMs like ASMI and ASML and manufacturing services providers like Flextronics, Foxcon and Jabil. Due to increasing equipment costs and costs of innovation each player tries to 'climb up', takes more responsibility at the customer and delegates more to the supplier. And the last one receives, and therefore has to take functional ownership to stay in the race. Behold: the importance of productization.

As a research participant pointed out: "In build-to-print we'll soon get in trouble, in build-to-specifications we can grow again."

Nowadays development and manufacturing become more integrated and OEMs select suppliers that combine the two. The bad news is that to date Dutch suppliers are either strong in development or manufacturing, but rarely master both (HTSC, 2014-2015). Last year ASML complained for good reason over the supply industry in the Netherlands: the Dutch suppliers contributed for some 1.7 B€ spend, but are for three-quarters build-to-print. The Germans however, accounting for about 1.3 B€ spend, are for two-thirds build-to-specifications or even build-to-roadmap suppliers (Link Magazine, 2015). Fear is that the high tech suppliers in the Netherlands do not have the scale, culture or courage to follow ASML's strategic sourcing approach and the supply base of the Dutch OEM shuffles slowly abroad.

The challenges of productization

Back to the ASML-VDL ETG wafer handler case again (Link Magazine, 2014). The transition is not yet fully completed. Both parties have to get used to the new way of working. One of the difficulties for ASML is 'to let go'. And for example working in a matrix, with both competency and project managers, within multidisciplinary development programs is new for VDL ETG. The latter is a complex change, not only for development and production, but also for procurement: roadmap alignment and execution of total cost of ownership programs with 2nd tier suppliers of wafer handler components is also necessary, since they no longer directly supply ASML but VDL ETG.

Amongst others the CPIM project (BOM, 2007) proved that productization has serious challenges: to move from build-to-print supply towards build-to-roadmap collaboration several obstacles must be overcome.

Collaborative Innovation in Dommel Valley

In 2007 the BOM initiated the Collaborative Product Innovation in Manufacturing (CPIM) project. Anticipating the change from subcontracting to collaborative innovation the aim of CPIM was to exchange insights in new collaboration forms. Participants were OEMs like Assembleon, FEI Company and Philips Electronics and suppliers like Bosch Rexroth, Frencken Europe, NTS-Group and Prodrive Technologies.

In traditional build-to-print subcontracting the OEM specifies in detail how a component should be built. The metaphor for this relation is the technical drawing in print. In case of underperformance the supplier is exchangeable for another. In the build-to-specifications constellation however a supplier responds to the specifications of the OEM by proposing a design and producing accordingly. To enable this OEM and supplier have to be able to work in multidisciplinary and cross-functional programs. A next step could be the OEM sharing its roadmap and future milestones. The supplier may align by elaborating the technologies to meet these milestones and by developing and delivering the constituting components as a module or sub-system: build-to-roadmap. The supplier ends up with life cycle responsibility and total cost of ownership of the modules that are part of the OEM system.

Productization of supply companies

From the CPIM project the following productization challenges emerged:

- ❖ **Capabilities and culture.** Does the supplier have the proper development and engineering capabilities and module and sub-system knowledge? Is the supplier able and willing to keep these capabilities up and running in downturns? Are the required collaboration capabilities like transition and project management at both OEM and supplier side in place? Is the OEM able to overcome the 'Not invented here' syndrome and leave development to suppliers? Is the supplier equipped to switch from a 'Your wish is our command' mode to a more proactive 'We think you can improve' mode of collaboration? How to alter the dominant 'left-to-right' way of working, with emphasis on operational excellence, to a 'right-to-left' customer in culture, focused on solutions?
- ❖ **Chain and change management.** Is the supplier prepared to apply the strategic sourcing concept also to itself and migrate its business model and value chain? Does the supplier have complete product creation (PCP), product delivery (SCM) and life cycle processes (PLM) in place? Does the supplier have compatible engineering change management practices (CCM) in place? How to deal with different PLM systems and procedures? Are both OEM and supplier willing to share their visions, roadmaps, market, demand, requirements and other strategic information? Are both parties willing to share their supply chain maps, choke points, dependencies, commitments, planning assumptions and other tactical and operational information? Do they align their business models, organization and business processes?
- ❖ **Contracting and governance mechanisms.** Are OEMs and suppliers willing to engage in risk-reward types of collaboration? How to deal with intellectual property (IP) that is built up in programs? Can suppliers reuse knowledge for other OEMs? Are there sufficient OEMs where the application and underlying technology potentially can be used again? What investments can be reasonably expected from suppliers and what are fair compensations for these investments? What are proper operating models and governance structures for both suppliers and OEMs itself and in relation to each other?

In general productization can only be successful if it is based on a shared and comprehensive view and on a clear-cut redefinition of business models and resulting rearrangement of business architectures and underlying business elements. Hence productization is truly a paradigm shift, making the ones to complete this shift real game changers (Osterwalder, 2010).

"Productization implies partnership and a shared vision about innovation in the value chain. Discussion should no longer be 'how to' but 'what to'. Put creation of value over cost, and effectiveness over efficiency. The relation is built on trust, which in itself is a composite equation of capabilities, reliability, and transparency as well as a healthy portion of self-interest." a research participant said.

Fokker Technologies

Fokker Technologies is a 1st tier developer and servicer of aircraft modules, with some 760 M€ revenues, 7% profit and about 5.000 FTE (~7% in development) staff (2014).

Over the last two decades Fokker grew from supplier of material application on components, via sub-assemblies to development and production of integrated modules. Today it is able to co-develop with system integrator OEMs like Airbus and Boeing.

Fokker's strategy is to concentrate on modules and integrated sub-assemblies. Only some highly complex components are manufactured internally. To increase freedom in product creation and reduce investments it outsources at a higher level: about 90% of Fokker's tail bill-of-material is sourced, against 40% in the past. Also design is handed over to suppliers.

It has an adaptive global supply base ('supply cloud') with regular, long-term partners. Technology, program management and supply chain management have become Fokker's key capabilities.

2. How does Productization work?

To date the scope of numerous research studies has been focused on outsourcing, primarily from OEM perspective (Pralhad and Hamel, 1990; Quinn and Hilmer, 1994) and hardly from supply side. Also, collaboration between partners - OEMs and suppliers - has been thoroughly investigated, predominantly from OEM side again (Mockzka, Handfield, Frayer, Ragatz and Scannell, 1999; Kaplan, Norton and Rugelsjoen, 2010; De Man, 2013).

Research aimed at the supplier's viewpoint on outsourcing, productization and partnering though has been limited, quite recent and partly still in its infancy (BOM, 2007; Point.one, 2010; Steenbergen, 2015).

Given the importance of productization and the benefits of successfully implementing an OEM-supplier collaboration, it is remarkable that relatively little is known about the productization concept. Therefore, a comprehensive productization maturity model, that integrates a company's characteristics and context, business strategy and architecture, from a combined OEM and supplier perspective, is of significant value to both practitioners and academics. In this White Paper such a model is introduced, that is validated through the analysis of over 20 interviews with executives and senior managers in The Netherlands.

Defining the company typology

To have a clear understanding of the different maturity stages, a company typology has been elaborated. The typology of this research consists of four distinct OEM profiles and four supplier profiles, which are a consolidation of the literature mentioned above as well as articles in various relevant business journals (Deal, 2013; Link Magazine, 2014) and company presentations at symposia (HTSC, 2014-2015) (figure 2).

Company typology	
OEM profile	Supplier profile
<ul style="list-style-type: none"> ❖ Vertically Integrated: OEM executes merely all business processes. 	<ul style="list-style-type: none"> ❖ Build-to-Print: produces components, based upon drawings of OEMs.
<ul style="list-style-type: none"> ❖ Limited Unbundled: OEM outsources manufacturing, and (parts of) assembly, testing and installation, whereas development, design, engineering, sourcing, integration and sustaining remain internal. 	<ul style="list-style-type: none"> ❖ Build-to-Print Plus: produces components, based upon technical product specifications of OEMs and assembles, tests and installs sub-assemblies.
<ul style="list-style-type: none"> ❖ Largely Unbundled: OEM outsources assembly and installation and (parts of) design and engineering, whereas development, sourcing, integration and sustaining remain OEM internal. 	<ul style="list-style-type: none"> ❖ Build-to-Specifications: designs, engineers, assembles and installs sub-assemblies to modules, based upon functional specifications of OEMs.
<ul style="list-style-type: none"> ❖ Virtually Integrated: except for research, sourcing and sales, OEM relies sec on external competencies. 	<ul style="list-style-type: none"> ❖ Build-to-Roadmap: develops, produces and sustains modules, based upon own and OEM-shared roadmaps.

Figure 2: Company typology and profile

The basic notion behind this typology is that a company - be it an OEM or a supplier - cannot migrate itself in a 'big bang' into an aimed for profile: to realize a successful transition not only the business model, but also the architecture of a company must be reinvented. Transforming for example a company from a build-to-print into a build-to-specifications supplier takes several steps: restructure the organization, set-up new and redesign existing processes, align the footprint, infrastructure and assets, add and expand content and collaboration capabilities, adjust KPIs, governance, contracting mechanisms and change management practices, risk appetite and funding, and ultimately culture and trust. This makes it impossible to just turn the company around in one go or bypass maturity stages. And that applies in this example for the supplier, but equally for the OEM. Therefore like the business model, business architectures are adapted in stages.

Productization of supply companies

Each company profile covers a specific part or specific parts of the value chain over the business life cycle: from the entire chain of the vertically integrated OEM and 'pure play' manufacturing services for the build-to-print supplier, to particular 'strategic control points' for the virtually integrated OEM and almost the full 'Original Module Manufacturer (OMM)' chain of the build-to-roadmap supplier (figure 3).

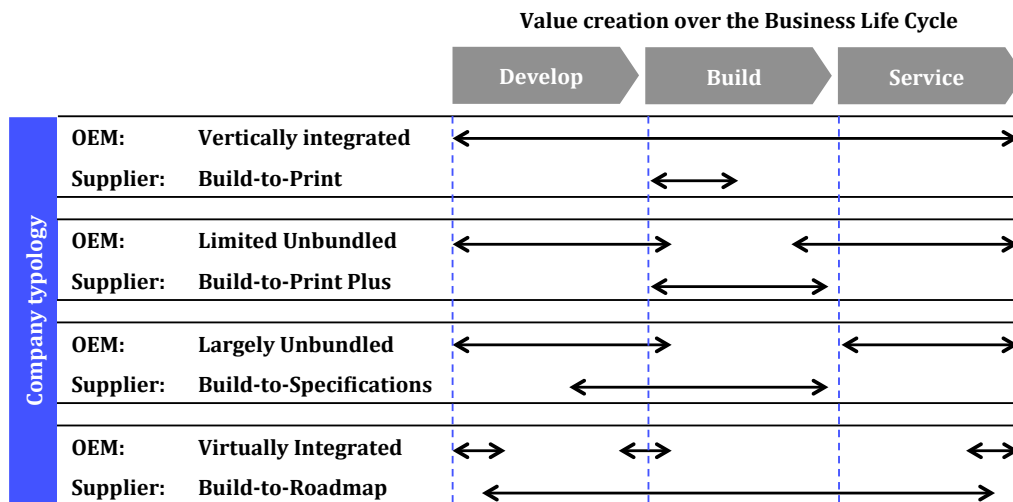


Figure 3: Company typology and value creation

Outlining the collaboration level

In addition to the changing profile of an OEM or a supplier the changing relationship between both of them plays an important role. Not only the business model and architecture must be adapted to make the transition successfully, also the way OEMs and suppliers interact should be adjusted. In their study on collaboration Millman and Wilson (1995) distinguish the following levels (figure 4):

- ❖ **Integrated.** At this level OEMs consider their build-to-roadmap suppliers as strategic partners. The perspective is therefore long term, life cycle based. Collaborative innovation is key, mutual trust essential and risk-reward mechanisms are in place. The value chain is virtually integrated.
- ❖ **Interdependent.** Both OEM and build-to-specifications supplier are mutually dependent at this level. Sustaining the mid to longer-term relationship is more important than accomplishing a single deal. Suppliers are single sourced, including new product introduction (NPI). Contracts are deliverables based. Trust is necessary. Chain alignment is growing.
- ❖ **Cooperative.** A build-to-print plus supplier is less critical for the OEM. Intention is to work towards a mid term relationship. Contracts are time and material (T&M) based, without guarantees. Trust is gaining importance.
- ❖ **Arms length.** There is no OEM-build-to-print supplier dependency whatsoever. The orientation is short term, without any intention of extending the relationship for future business. Limited to none switching costs. Trust is convenient at most. No chain alignment.

Productization of supply companies

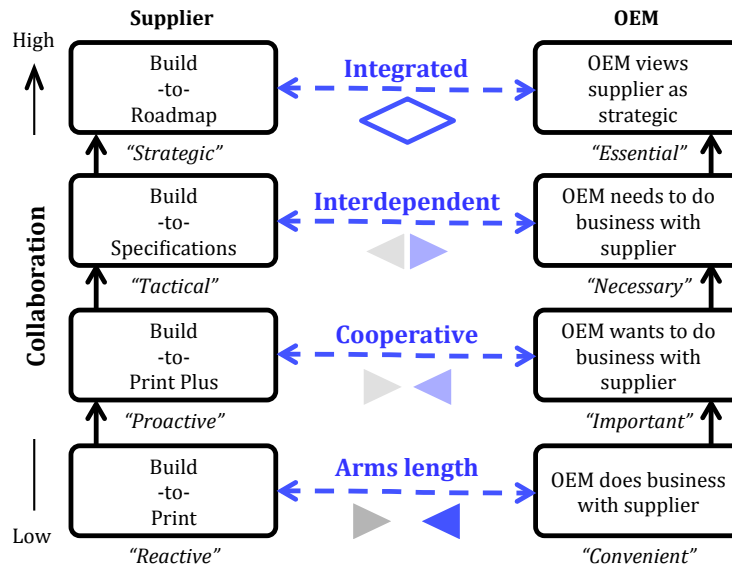


Figure 4: Collaboration levels

The unifying maturity model for productization

By integrating (i) the four different company profiles - for OEMs as well as suppliers -, and (ii) the four different collaboration levels between OEMs and suppliers a holistic maturity model dedicated to the challenges of productization is created (figure 5).

		Maturity stage			
		No productization	Ad-hoc productization	Semi productization	Full productization
OEM	Company profile	Vertically integrated	Limited unbundled	Largely unbundled	Virtually integrated
	Core competence	R&D, D&E, Assembly, SI, S&S	R&D, D&E, SI, S&S	R&D, Sourcing, S&S	Research, SCM and M&S
	Sourcing strategy	Procurement	Sourcing	Strategic sourcing	Built 2 Business
	Performance criteria	QC (Spend)	QLC (Spend)	QLTC (NPI TCO)	QLTC (PLC TCO)
	Risks	Inflexibility (scale & scope)	Inflexibility (scope)	Accomplishment specs (application)	Supplier lock in (technology)
	Ownership	Client, IP, application, assets	Client, IP, application	Client, IP (fore / background)	Client, IP (background)
Relation	Collaboration	Arms length	Cooperative	Interdependent	Integrated
	Perspective	Short term (<1 year)	Short term (1-3 years)	Mid term (3-5 years, NPI)	Long term (>5 years, PLC)
	Scope	OEM & many suppliers	OEM & limited suppliers	OEM & few suppliers	OEM & value chain
	Specification	Single sided (OEM)	Single sided (OEM)	Single sided (OEM)	Mutual, two sided (OEM & Suppliers)
	Mechanism	Cost based (Time & material)	Cost based (Time & material)	Performance based (Deliverables)	Revenue based (Risk-reward)
	Trust	Convenient	Important	Necessary	Essential
Supplier	Company profile	Build-to-Print	Build-to-Print Plus	Build-to-Specifications	Build-to-Roadmap
	Output ('product')	Components	(Sub-) Assemblies	Modules	(Sub-) Systems
	Trigger	Drawing	Technical product description	Functional specification	Roadmap
	Core competence	Production	Assembly, Installation	Engineering, SI	Development, PM, PLM
	Risks	Expensiveness (Efficiency)	Expensiveness (Efficiency)	Feasibility specs (Effectiveness)	Applicability technology (ROI)
	Ownership	Assets (capacity)	Assets (capacity)	Application (capability)	Roadmap, IP (foreground)

Figure 5: Productization maturity model

Validation of this model by the research opens up the theoretical framework for practical and real-world analyses of steps to take and activities to plan, when moving a productization maturity stage.

In order for this model to be operable each cell needs to be populated by the proper completion on all aspects of the underlying business architecture and constituent elements. Based on extensive desk research the unique combination of a company's characteristics and context, the distinctive aspects of its business model and strategy and required matureness of the business elements are disclosed.

3. What research is done towards Productization?

The objectives of this research were:

- ❖ **Status and trends.** Determine the current status and future trends of outsourcing, productization and collaboration in manufacturing industries in the Netherlands.
- ❖ **Way of working.** Elaborate the business models and underlying business architecture and elements of both OEM and suppliers and identify best practices and improvement actions to advance the Dutch industry one step further.

The focus of the research has been on leading Dutch companies - OEMs and suppliers - in the high and medium tech industries. It was not the goal of the research to be representative, but to obtain insights into future developments and reveal best practices. To this end it was expected that leading companies provide the best opportunity. The scope was limited to high and medium tech industries since literature and experience shows that outsourcing and counterpart productization are furthest developed in these sectors. Given the research's intention to progress the Dutch industry to the next level and preserve craftsmanship and employment in the Netherlands the emphasis was on Dutch companies.

The study concentrated on five key research questions regarding the productization process:

- ❖ **Transformation.** Do value chains - especially OEMs, 1st tier suppliers and their mutual collaboration - develop according to specific productization transformation stages over the business life cycle?
- ❖ **Drivers and inhibitors.** What are the key drivers and inhibitors to move to a next productization transformation stage?
- ❖ **Maturity levels.** What are the actual and required productization maturity levels?
- ❖ **Business elements.** What are the levels of the underlying business elements?
- ❖ **Best practices.** What are productization best practices in the manufacturing industry?

The research process consisted of five phases: (i) scoping of the research, (ii) desk research including literature, (iii) field research with structured interviews, applying the productization questionnaire, (iv) validation of the preliminary findings in a round table session and (v) reporting of the validated findings in this White Paper (figure 6).

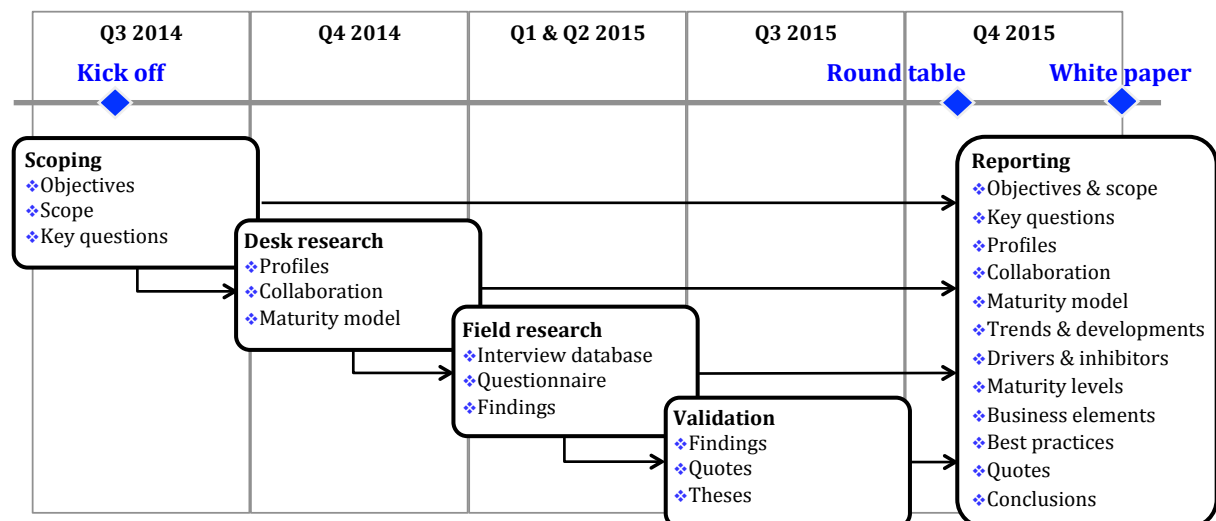


Figure 6: Research process

Productization of supply companies

Research method

During the desk research the productization maturity model has been prepared and the OEM and supplier profiles and collaboration levels defined.

Based upon the desk research findings the productization questionnaire was developed. The foundation of the questionnaire consists of the six business elements of a company: (i) Business Model & Strategy, (ii) Management & Organization, (iii) Processes & Supply Chain, (iv) People & Culture, (v) Information & Infrastructure and (vi) Performance & Improvement (KPIs). Evolving from the initial work by Nolan and Gibson (1974), it is well established that these business elements - which combined constitute a company's business architecture and are often referred to as the clover leaf model - need to be addressed to take a transformation step by step in order to control a company's performance and direction.

For each business element the six most relevant aspects are elaborated: the questionnaire comprised in total thirty-six business element related questions (figure 7). Each question consists of a four points scale: the higher the score, the more the company is geared towards virtual integration or full productization.

Element	Business Model & Strategy	Management & Organization	Processes & Supply Chain	People & Culture	Information & Infrastructure	Performance & Improvement
Aspects	<ul style="list-style-type: none"> ❖ Market maturity ❖ Value proposition ❖ Customer/supplier relationship ❖ Business model ❖ Out/insourcing level ❖ Vision/roadmap alignment 	<ul style="list-style-type: none"> ❖ Organization design ❖ Innovation/development governance ❖ End-to-end chain governance ❖ Service/sustaining governance ❖ Organizational interfacing ❖ Business planning linkage 	<ul style="list-style-type: none"> ❖ Key value creation life cycle processes ❖ End-to-end chain integration ❖ Market/demand visibility ❖ Requirements development ❖ Chain insight/choke points ❖ Commitment/planning 	<ul style="list-style-type: none"> ❖ Pivotal people ❖ Staff attitude ❖ Staff focus ❖ Left-to-right/right-to-left culture ❖ Change mgt/communication ❖ Relationship/stakeholder mgt 	<ul style="list-style-type: none"> ❖ Master data management ❖ Configuration management ❖ Info sharing and interfacing ❖ Escalation/dispute resolution ❖ Systems linkage/integration ❖ Cross company resourcing 	<ul style="list-style-type: none"> ❖ Contract preparation/mgt ❖ Shared measures/targets ❖ Incentive mechanisms ❖ Governance/benefits tracking ❖ Commercial/legal arrangements ❖ Improvement/investment plans

Figure 7: Business elements and aspects per business element

Next to the business element questions the questionnaire contains contextual questions with respect to the applicability, drivers and inhibitors of outsourcing as well as productization and the match of demand and supply. Finally the questionnaire includes questions regarding the characteristics of the company in terms of division of revenue shares over supply categories; spend shares of demand categories and staff shares per function in the past, the present and the future. Prof. Dr. A.P. de Man of VU University Amsterdam has validated the productization questionnaire.

With the questionnaire data are gathered in interviews with 23 executives and senior managers within 17 companies, partly emerged from the BOM network and/or members of Brainport Industries and all active in the high or medium tech manufacturing industry in The Netherlands. Next the data were collected in a database and analyzed on (i) correlations between questions, (ii) typical leading and lagging questions and (iii) remarkable discontinuities per company type - OEM or supplier -. Moreover (iv) gaps between OEMs and suppliers were elaborated in detail.

The preliminary findings are validated and relevant theses discussed in a round table session with executives and senior management of 6 participating companies - OEMs and suppliers -.

Ultimately the validated results and derived conclusions are reported in this White Paper.

4. What are the results?

The first research findings are that (i) outsourcing and counterpart productization expand and (ii) OEMs and suppliers over time transform accordingly in their quest to (iii) close the demand and supply gap (figure 8):

- ❖ **Outsourcing.** The OEM outsourcing degree is expected to grow for about all OEMs in merely all high and medium tech industries.
- ❖ **Productization.** The productization of supply companies is also expected to grow, but to date it is situational, only a limited number of suppliers have gone through this transformation.
- ❖ **OEM transformation.** Although the spend shares per supplier profile can differ per sector and company, it seems that in general the build-to-print share shrinks slowly. The build-to-specifications stake though grew fast in the past and increases somewhat more gradually in the future, whereas the build-to-roadmap share tends to enlarge steadily over time. Supply bases are predicted to decrease. Regarding the division of staff, the share of developers grows relatively at the expense of operations staff, while the sales and service part remains flat.
- ❖ **Supplier transformation.** Here too are major differences per sector and company, but the supply of modules roughly grew and continues to do so to the detriment of sub-assemblies. Components declined but appear to have stabilized. With respect to the division of staff, the small amount of engineers within suppliers increases, the traditionally large manufacturing share drops and the minor sales and service part grows slightly.
- ❖ **Demand and supply.** The current OEM demand is largely covered (gap <20%). Aim is to eliminate the gap and match demand and supply as far as possible (gap <5%). A mismatch has a large financial impact and can cause a direct supplier switch and customer loss. It is seen as a make-or-break issue that should have strategic priority.

		Was (-3y)	Is (2015)	To be (+3y)	Trend
OEM spend share*	Build-to-print	25-50%	20-50%	15-50%	↓
	Build-to-specifications	0-25%	5-40%	10-40%	↑
	Build-to-roadmap	10-75%	20-75%	30-75%	↑
Supply revenue share*	Components	0-50%	0-40%	0-40%	↓
	Sub-assemblies	0-95%	0-90%	0-80%	↓
	Modules	5-75%	10-75%	20-80%	↑
OEM staff share*	Design & engineering	20-40%	25-50%	30-50%	↑
	Manufacturing	40-70%	30-60%	15-50%	↓
	Sales & service	10-40%	10-40%	10-40%	Flat
Supplier staff share*	Design & engineering	0-5%	10-15%	15-25%	↑
	Manufacturing	90-95%	80-90%	70-85%	↓
	Sales & service	0-10%	0-10%	5-10%	↑

* Large differences per industry and company.

Figure 8: Outsourcing and productization trends

Overall the research indicated that both outsourcing and productization trends are regularly - but not always - applicable, but the scale and speed depends on era, sector and company.

Productization of supply companies

Drivers and inhibitors

Furthermore the research showed that for OEMs core competence focus and restructuring are the main outsourcing drivers, while for suppliers growth and customer lock-in *plus* OEM pressure are the major productization drivers:

- ❖ **OEM outsourcing** (figure 9). The key driver is focus on core business, modules and applications. Cost restructuring and free up of working capital are close second and third drivers for outsourcing.
- ❖ **Supplier productization** (figure 9). The major drivers are business growth of suppliers and customer lock-in. Suppliers are often forced by OEMs to create value beyond manufacturing services.

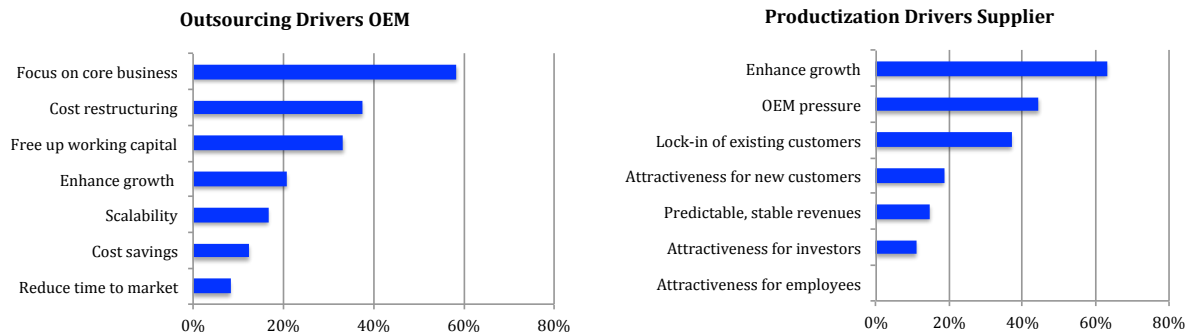


Figure 9: Outsourcing and productization drivers

Apart from financial inhibitors, the research found that OEMs fear dependency and resistance, whereas lack of value-adding capabilities is the key productization showstopper for suppliers:

- ❖ **OEM outsourcing** (figure 10). The main OEM outsourcing inhibitor is increased dependency on and risks regarding suppliers. Resistance to outsourcing and lack of a compelling business case are also strong inhibitors for outsourcing.
- ❖ **Supplier productization** (figure 10). The major productization inhibitor is lack of a compelling business case. Insufficient capabilities in the field of product generation and development, supply chain and life cycle management as well as missing, locally present, design and engineering capabilities are also tough inhibitors for suppliers.

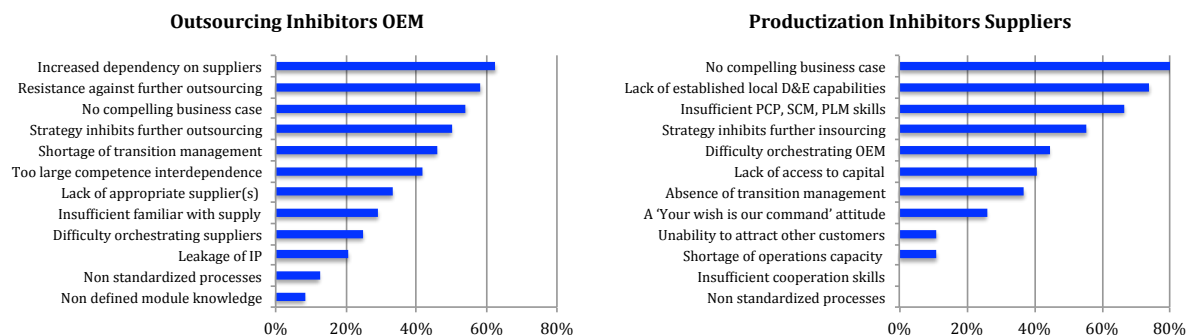


Figure 10: Outsourcing and productization inhibitors

What stands out is that drivers are usually strategic or financial, whereas inhibitors are often also emotional and cultural.

A representative of an OEM that participated said in favor of outsourcing: "An OEM hopes that a 1st tier supplier realizes chain cost reductions, that OEMs themselves are unable to realize". Another as inhibitor: "Dutch suppliers are still too generic, have too little focus. Adding engineers to 'fill the mill' is not enough".

Productization of supply companies

Quotes of participating suppliers supporting productization: “Build-to-print is a 'red ocean' fight while a build-to-specifications positioning has a 'blue ocean' alike character” and “We need to shift with our customers, deliver customized technologies and stay away from commodities. Otherwise we will be chased and eaten by other large 'forward pushing' foreign 1st tier suppliers”.

On the other hand it was stated several times by supplier representatives that: “We regularly come across schizophrenia between a long-term partnering vision (total cost of ownership) and a short-term procurement approach (spend savings) within OEMs”.

Maturity stages

To pinpoint the match between demand and supply and determine the current status of OEM outsourcing, supplier productization and mutual collaboration the participating companies - OEMs and suppliers - have been analyzed and mapped on the maturity model (figure 11):

- ❖ **OEMs.** The OEMs are for a large part unbundled and at the (beginning of the) semi productization stage, requiring predominantly build-to-specifications supply, based upon interdependent collaboration. The frontrunners migrate towards virtual integration, whereas for a few laggards unbundling is in its infancy, they cooperate primarily with build-to-print plus suppliers.
- ❖ **Suppliers.** The supplier’s maturity has a large bandwidth. They are on average at the (end of the) ad-hoc productization stage. The majority has a build-to-print plus profile, producing components and assembling sub-assemblies. Their OEM relationship is proactive, but at best they are important for OEMs, not indispensable. Only a single supplier has an overall build-to-specifications positioning, which makes them interdependent with OEMs.
- ❖ **Demand and supply.** Aforementioned average positioning of OEMs and suppliers implies a maturity gap: a frontrunning or even a typical OEM does not automatically get what it requires from its regular supply base. As such, the research shows a mismatch between the current requirements of OEMs and the ‘products’ or services that suppliers in a broad ‘tangible and intangible’ sense offer.

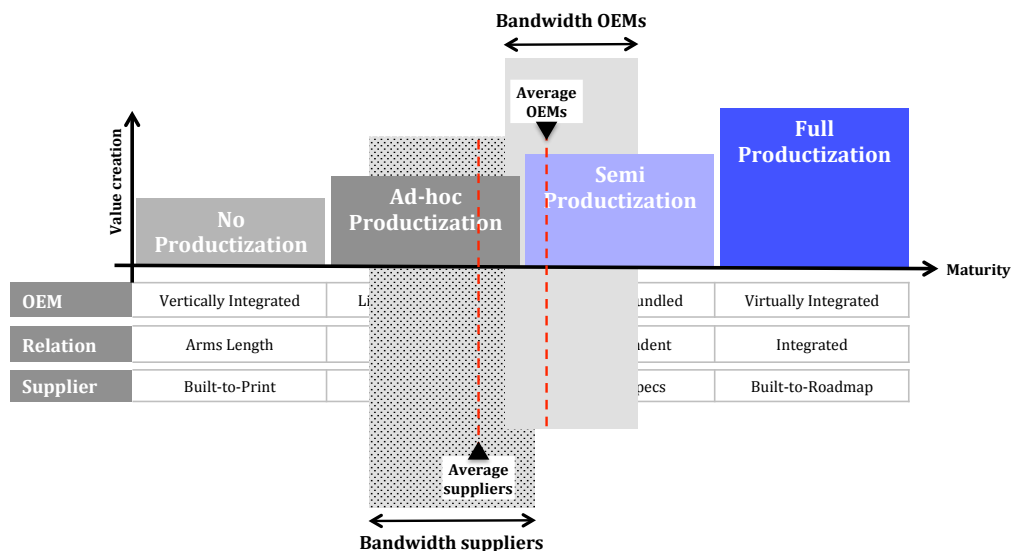


Figure 11: Maturity gap

Overall suppliers lag in productization maturity, when compared to OEMs; they are largely at the semi productization stage, while suppliers mostly still have a build-to-print plus profile. It seems that to date limited Dutch suppliers have made the transformation from build-to-print component manufacturer to build-to-specifications supplier and none to build-to-roadmap partner. Meanwhile - as shown above - OEMs expect them to do so.

Productization of supply companies

As a research participant underlined: "Given the migrating OEM demand suppliers have to shift in the build-to-specifications direction to stay in business. Moreover, in the long term wage developments in the Netherlands are not in favor of a build-to-print profile only".

Business elements

The research reveals that all business elements of suppliers - compared to OEMs - somewhat lag or at best more or less match:

- ❖ **OEM business elements** (figure 12). Especially Management & Organization and to a lesser extent Business Model & Strategy maturity is well above average when compared to the other business elements of an OEM, and certainly when compared to the same business elements of suppliers. These business elements are known as tactical and strategic dimensions. Information & Infrastructure and in particular Performance & Improvement lag. The latter also in comparison with the score of suppliers.
- ❖ **Supplier business elements** (figure 12). Although the business elements of suppliers in general are less mature, especially Management & Organization and to a somewhat lower degree Business Model & Strategy are falling behind. For example a core competence approach and application of the strategic sourcing concept or working in a matrix with programs including multidisciplinary projects instead of within a functional, competency based structure are lagging, compared to OEMs. Remarkably enough suppliers lead the way regarding Performance & Improvement, a relatively operational KPIs oriented dimension. Apparently suppliers are relatively target and progress focused.

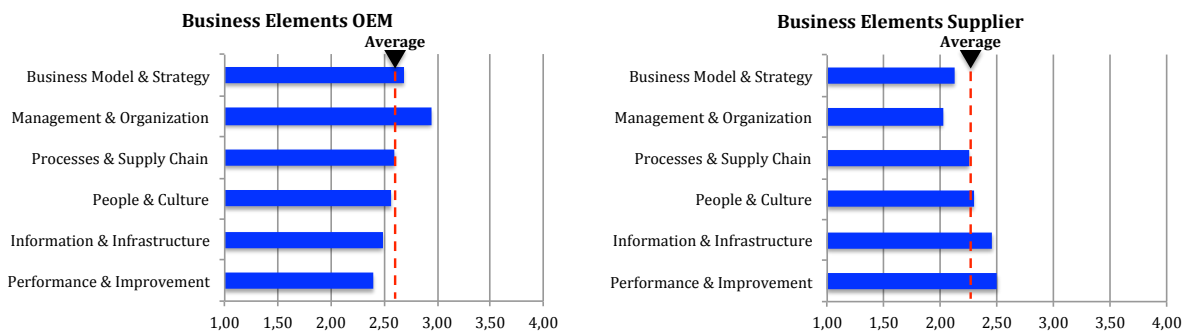


Figure 12: Overall business elements

It was found that OEMs transform easiest in strategic 'business model' and tactical 'organization' dimensions. Suppliers however transform straightforward in operational 'information' and 'improvement' dimensions. This contradiction creates a mismatch and contributes to the difference in transformation speed between an OEM and its 1st tier supplier.

Next to the overall comparison of the business elements, research findings on the detailed results per business element can be listed. This concerns comparisons between OEMs and suppliers, as well as comparisons of the underlying relevant aspects per business element within an OEM or supplier.

- ❖ **Business Model & Strategy** (figure 13). Compared to suppliers, OEMs face more market maturity. OEMs sell value added systems and customized, integrated solutions, whereas suppliers move towards development and delivery of sub-assemblies and modules. Their mutual relationship focuses on extending sales at existing customers and the other way around extending spend at existing suppliers: their collaboration intensifies. Both OEMs and suppliers share visions and intents, but alignment with respect to proposition, roadmap, business model and so on is limited effectuated. OEMs seem to be more open for external stimuli and have business models that integrate third party technologies, products and services more easily. Compared to suppliers OEMs are miles ahead in terms of unbundling. In other words to date the outsourcing level of suppliers is very limited.

Productization of supply companies

❖ **Management & Organization** (figure 13). Suppliers are predominantly functionally organized, whereas OEMs are organized around businesses and multidisciplinary programs. Compared to suppliers, OEMs govern development (PCP) and chain delivery (SCM) more maturely. Service and sustaining (PLM) are terra incognita for suppliers. Both OEMs and suppliers have some contract based collaboration arrangements in place with streamlined organizations and processes. Businesses are linked by (ad-hoc) joint meetings between executives, to discuss broader requirements and strategic issues as well as some business planning and alignment. Implementation however is still immature.

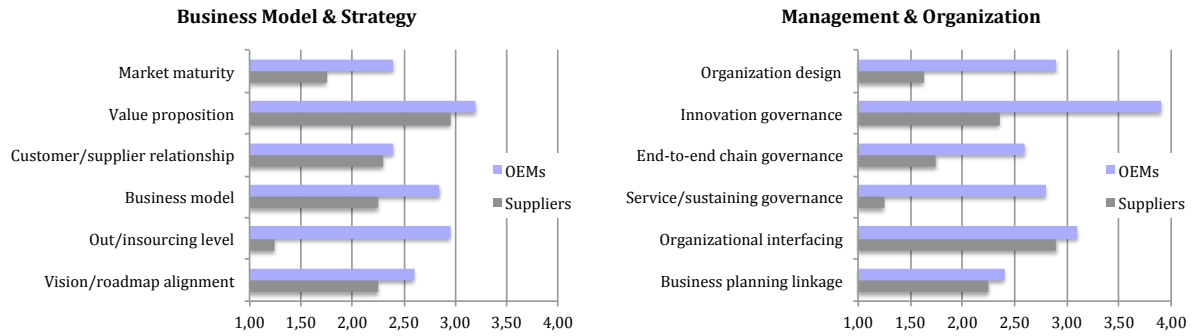


Figure 13: Business Model & Strategy and Management & Organization business elements

❖ **Processes & Supply Chain** (figure 14). Both OEMs and suppliers claim to know what their key value creating processes are. They have insight in and an understanding of the supply chain and choke points. Market developments, demand visibility, dependencies and competition issues however are barely jointly discussed with a regular frequency. The end-to-end chain integration is limited to the delivery processes of the OEM and its 1st tier suppliers only. OEMs move to functional requirements, whereas suppliers to date usually work with technical (TPD) requirements. Regarding commitments and planning OEMs use formal reviews, suppliers are more improvising.

❖ **People & Culture** (figure 14). There also seems to be OEM-supplier alignment with respect to their mutual (future) pivotal people. Management of staff and stakeholders is aligned both within and between companies. OEM staff attitude and culture are more geared to customer needs and specifications ('right-to-left'); suppliers emphasize operational excellence and fulfillment ('left-to-right'). Change management alongside business issues is formalized (CCM light) at OEMs, but more ad-hoc, operational 'firefighting' by suppliers.

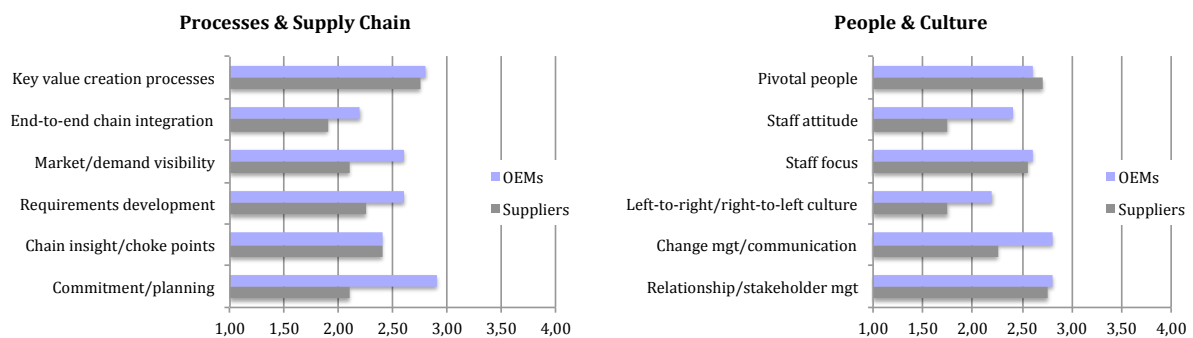


Figure 14: Supply Chain & Processes and People & Culture business elements

❖ **Information & Infrastructure** (figure 15). Escalation and dispute resolution is aligned: information sharing and communication at horizontal levels. Co-location plans creating virtually integrated teams exist. As already stated in the Supply Chain & Processes business element OEMs move towards functional master data, suppliers are at TPD level. Strangely enough configuration management is lagging at OEMs, when compared to suppliers. Some OEM infrastructures (ERP, CRM and PLM systems) are externally linked, whereas supplier systems still are largely silod.

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- ❖ **Performance & Improvement** (figure 15). Contracts are in place; preparation and management are standardized including shared quality, logistics, innovation and costs (QLTC) targets for development and delivery, not for sustaining. Incentive mechanisms to reward the collaboration are rarely used. Compared to suppliers OEMs even lag with respect to for example risk-reward types of contracts. Some quite embryonic evidence of joint governance mechanisms and benefits tracking was found. Commercial and legal arrangements (open book costing, ROI framework, IP policies) are not standardized and only partially in place. The same counts for improvement and improvement plans.

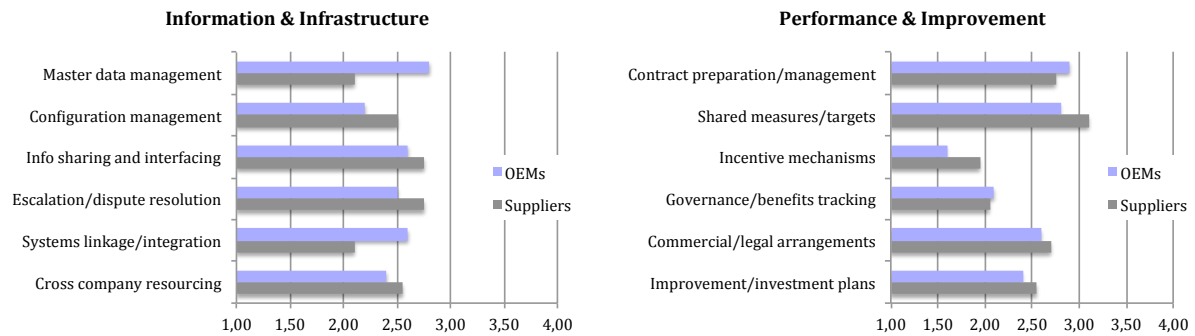


Figure 15: Information & Infrastructure and Performance & Improvement business elements

As already stated the overall maturity of the business elements of suppliers lag, nevertheless visions and intentions are shared, stakeholders involved and information and targets aligned. Yet supplier business models, organization and governance are to be enhanced, value-adding capabilities to be built and systems to be linked. Contracting mechanisms and change management are to be matured on both sides.

Best practices

During the course of the research - in both literature and interviews - several best practices were found per business element (figure 16).

Business Element	Best Practice
Business Model & Strategy	<ul style="list-style-type: none"> ❖ Focus on few collaborations and integrate internal / external parties virtually with an open, collaborative business model. ❖ Transfer of strategic sourcing concept along entire chain ('connected corporation'). ❖ Align strategies and link business planning cycles within collaborations. ❖ Safeguard consistent outsourcing / productization policy, despite management changes.
Management & Organization	<ul style="list-style-type: none"> ❖ Single point program / project accountability. ❖ Govern innovation (PCP) as a portfolio of internal and external activities / parties (ESI). ❖ Manage chain from end-to-end perspective (full transparency OEM / all tiers). ❖ Organize sustaining around customer solutions.
Processes & Supply Chain	<ul style="list-style-type: none"> ❖ Map and assess whole chain and all participants (incl. OEM) for each QLTC(S) perspective. ❖ Share market information and demand and recognize dependencies and competition issues. ❖ Orchestrate whole chain (incl. understanding of potential choke points) for mutual benefit. ❖ Fully recognize forward commitments, planning issues and collaboration requirements.
People & Culture	<ul style="list-style-type: none"> ❖ Joint (pre-competitive) development and change programs with open communication. ❖ Joint stakeholder management (incl. 'PLC Stakeholder' matrix for customer requests). ❖ Relocate OEM development staff of outsourced activities, to prevent from NIH behavior. ❖ Adjust supplier DNA and culture: from reactive production only to proactive product and customer ('CTO is change manager').
Information & Infrastructure	<ul style="list-style-type: none"> ❖ Share roadmaps, joint requirements development, specify on functional level. ❖ Use coherent, joint horizontal escalation bodies, on a fully equal basis. ❖ Interface joint systems for information sharing (PLM, ERP, CAD/CAM etc.). ❖ Use joint co-location plans (incl. virtual pools, cross company working and learning).
Performance & Improvement	<ul style="list-style-type: none"> ❖ Deploy proper contract management (business case, ROI, IP etc.) without micro management at low organizational levels. ❖ Embed QLTC (PLC) targets, measurements (SMART) and improvement (Action plans). ❖ Install incentive based (performance, deliverable and risk-reward) contract instead of T&M. ❖ Establish joint governance and benefits tracking.

Figure 16: Best practices

The applicability as such, as well as the extent and manner of applicability of above-mentioned best practices depends on the maturity stage of both OEM and supplier. Companies that plan improvement actions should take their (aimed for) business model as a starting point, have a clear understanding of what they do well and balance intended enhancements in the related business elements.

5. What are our conclusions?

We have drawn the following conclusions from this productization research.

Outsourcing and counterpart productization are real

In high and medium tech industries outsourcing and productization likewise grow and value chains subsequently transform. The research results indicate that OEMs and suppliers develop according to specific maturity stages. We found strong evidence from correlations in business elements and interview statements: 'now we are a build-to-print plus supplier, but we are moving towards a build-to-specifications profile'. The most mature OEMs are mounting up towards virtual integration, whereas the most ambitious suppliers, currently predominantly with a built-to-print plus profile, on the verge of becoming build-to-specifications supplier, already put a dot on the horizon to grow into (a variant of) a build-to-roadmap partner.

Productization is valuable, but not easy

Core competence focus is an OEM's main outsourcing driver, whereas growth, customer lock-in *plus* OEM pressure are the major productization drivers for suppliers. Besides financial inhibitors, OEMs fear dependency and resistance, while suppliers lack value-adding capabilities. Our research proves that OEM outsourcing is here to stay, now more than in the past. Productization to date, however, is situational, only a limited number of cases exist in the Netherlands.

OEMs are largely at the semi productization stage, expecting build-to-specifications supply, while suppliers mostly still have a built-to-print plus profile: the OEM-supplier maturity gap. Besides there seems to be a second gap, the OEM-supplier transformation gap: OEMs and suppliers interests are sometimes conflicting, think for example of lower OEM costs versus higher supplier margins. OEMs deal with that from a more strategic (proactive) viewpoint, suppliers in an operational (reactive) manner. Hence the productization transformation can be characterized as the 'hopping procession of Echternach': three steps forward, two steps backward.

As such today's supplier propositions insufficiently meet the demand of OEMs. And that is not a good thing for the supply sector in the Netherlands: in this way Dutch OEMs will in time set their sights abroad and their collaboration with foreign suppliers grows. Therefore, there is work to be done, both for suppliers and OEMs. Acceleration is required, starting with:

- ❖ **OEMs.** Align business and sourcing: focus on business management rather than the board, and pursue long-term business impact instead of short-term financial savings (Rietveld, 2009). Quit transaction based 'win-lose' procurement thinking, bickering over price, but focus on value (De Man, 2013).
- ❖ **Suppliers.** Focus in profile (build-to-print or build-to-specifications or build-to-roadmap instead of 'and and and') and business model (in tier, core competences, mechanisms etc.).

Productization has steep thresholds

Powered by robust strategic or financial drivers, yet restrained by often emotional and cultural inhibitors, productization is a tough process, taking a significant amount of effort; in time, capacity and tenacity.

It is widely known that 'climbing up the chain' towards the end market generates higher margins. Therefore, apart from the OEM pressure, becoming a build-to-roadmap supplier in itself is attractive. However, transforming from a build-to-print subcontractor up to a build-to-roadmap supplier imposes serious requirements, including:

- ❖ **Way of working.** From capability based activities to multidisciplinary development programs, with both capability and project managers. And ultimately from a time-based program, with a portfolio of projects with a start and an end, to life long 'products' that never 'stop'.
- ❖ **Mindset.** From a reactive 'Your wish is our command' attitude towards a proactive, committed and target and customer based culture.

Productization of supply companies

- ❖ **Focus.** Alongside continuous development and maintenance of the proprietary technology and application, focus should be on the product and the market, not at a single OEM but on sectors and multiple OEMs.
- ❖ **Investments.** Obviously in a technology roadmap and engineering and program management capabilities, but also in marketeers, business developers and people that understand IP protection.

Aforementioned step is very big, usually too big for 'a big bang'. Or stated differently, it requires a gradual transformation with intermediate steps that brings a company to a relative stable next stage. Other than that, deep pockets, patience and courage are the necessary ingredients.

Prodrive Technologies

During the productization field research Prodrive Technologies is often mentioned as an example of a best-in-class Dutch build-to-roadmap supplier. It is a one-stop-shop electronics integrator with some 120 M€ revenues and 600 FTE (~50% in development) staff (2014). Its 'DNA' is centered on customers, technology and continuous improvement. Based upon an own product roadmap it develops proactively for multiple OEM customers and prospects. Its strategy contains upfront commitment, balancing of investments, risks and rewards and coverage of warranty, liability and life cycle management.

The Productization maturity model and best practices can help

Both productization maturity model and best practices can contribute to structure the transformation. The questionnaire in itself already prompted many interviewees with the quote: "That is a comprehensive checklist for our productization strategy, we can already use". The maturity model provides an easy to understand framework to assess the current position and plan the future roadmap. It offers companies - OEMs as well as suppliers - that struggle with this transformation process a guideline to accelerate and arrange the process to receive and deliver considerable value beyond manufacturing services. Same counts for the identified best practices: if used timely and wisely, they can support the development of both OEMs and suppliers in their pursuit of productization.

Productization of supply companies

Overview of interviewees

Company	Interviewee(s)	Function
Aeronamic	Reinoud Siezen	VP Business Development & Programs
ASML	Frank Biemans / Wim Waeghe	SVP Strategic Supply Management / VP Strategic Supply Management
Assembleon	Jeroen de Groot	CEO
Brabant Development Agency (BOM)	Coen Sanderink	Project Manager
Brainport Industries	John Blankendaal	Managing Director
Eriks	Richard Groot	Director
FEI Company	Hein Gijsbers	VP Operations & Supply Chain
Festo	Max van den Berg	Senior Project Consultant
Fokker Technologies	Victor Schols / Toine Verbruggen	Director of Programs & Sales / VP Procurement & Supply Chain Management
Frencken Europe	Henk Tappel	Managing Director
Huisman Equipment	Johan Siau	Strategic Buyer
KMWE	Edward Voncken	CEO
Nedschroef	Tom van Strien	VP Trade & Logistic
Neways Technologies	Hans Ketelaars	Managing Director
NTS-Group	Eric Hezemans / Wim Steenbergen / René van Wijk	MD Systems Development / Program Manager / Director Mechatronics
Océ	Michiel Hekkens / Martijn van Hoorn	CPO / VP R&D
Philips Electronics	Kees Donkers	Director NPI
VanDerLande Industries	Edgar Beers	CPO
Van Knippenberg Consultancy	Mathé van Knippenberg	Consultant (former Supply Chain Development Manager ASML)
VDL ETG	Guustaaf Savenije	CTO

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List of abbreviations

Abbreviation	Stands for
CAD/CAM	Computer Aided Design / Computer Aided Manufacturing
CCM	Change and Configuration Management
CRM	Customer Relationship Management
CTO	Chief Technology Officer
D&E	Design and Engineering
ERP	Enterprise Resource Planning
ESI	Early Supplier Involvement
IP	Intellectual Property
NIH	Not Invented Here
NPI	New Product Introduction
OEM	Original Equipment Manufacturer
OMM	Original Module Manufacturer
PCP	Product Creation Process
PLC	Product Life Cycle
PLM	Product Life Cycle Management
PM	Program Management or Project Management
QLTC(S)	Quality, Logistics, Technology and Costs (and Services or Sustainability)
R&D	Research and Development
ROI	Return On Investment
S&S	Sales and Services
SCM	Supply Chain Management
SI	System Integration
SMART	Specific, Measurable, Achievable (or Actionable), Realistic (or Relevant), Time-based (or Time-bound)
T&M	Time and Material
TCO	Total Cost of Ownership
TPD	Technical Product Documentation

About the authors

Paul Schuurmans is a Partner of Praetimus. He is an operations expert, with broad experience in procurement and supply chain management. Paul worked for multinational companies in high tech, manufacturing and transport industries: as industrial engineer in the industry at DAF Trucks and as a consultant serving the industry at KPMG Consulting, Nolan, Norton & Co. and Atos Consulting. The strategic sourcing concept and related productization theme has his special interest since 1995.

Frank Marks is a Partner of Praetimus. His areas of expertise are strategy development and execution and improving operations at multinational high tech and manufacturing clients: in various technology and marketing roles in the industry at Philips Electronics and as a consultant serving the industry at KPMG Consulting, Nolan, Norton & Co. and Atos Consulting. Frank is a well-known servitization champion.

Leon Ramselaar is a Partner of Praetimus. Leon is a marketing and sales expert with broad experience in multinational high tech, trade and service industries: in various executive management positions and advisory roles 'in' the industry at Philips Electronics and as a consultant serving the industry at Atos Consulting. He is a customer centric innovation champion.

About Praetimus

Praetimus - the Value Engineers - is a niche strategy consulting & execution management boutique, that consists only of seasoned professionals with 25+ years of relevant experience, both in leadership positions in the industry or serving the industry. Praetimus is Latin and stands for "We will create value". It is geared towards value creation across the entire business model and focuses on innovation, commerce and operations of companies in high tech & manufacturing, transport & trade and services sectors.

About Brabant Development Agency (BOM)

The mission of the Brabant Development Agency (BOM) is to create, improve, maintain and develop the industrial and economic structure in Brabant, a region in the south of the Netherlands, by offering a range of professional services. The focus areas of the BOM are high tech and life tech sectors. It is funded and financed by the Dutch State and the Province of Brabant.

About Brainport Industries

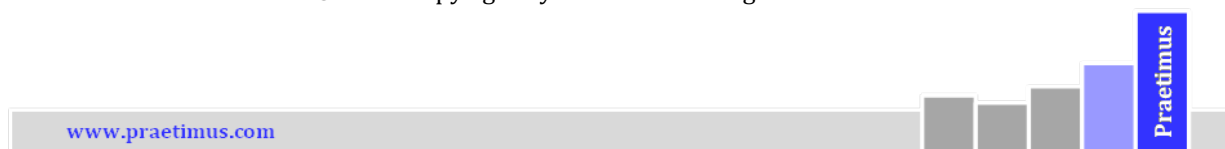
Brainport Industries is the world's leading open supply chain for high tech companies, with the ambition to further strengthen and develop it. It is a membership network of 1st, 2nd and 3rd tier suppliers, providing a fertile ground and a solid structure for collaborative projects whether they are related to technology, market or people.

Productization of supply companies

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