

# Well Considered

## The product development process

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\_\_\_\_\_ The foundation for the success of a product is laid in the product development process (PDP). It includes all phases of development and describes the core processes involved in launching a product on schedule, on budget, and with the desired quality. Porsche Engineering makes its process capabilities and experience from sports car series development available for a wide variety of development projects in the automotive industry and beyond. This experience allows to take account of preceding and subsequent PDP phases in every development. Porsche Engineering can cover the entire product development process itself, work within the framework of customer-specific PDPs, enhance existing PDPs, or develop completely new ones.

The product development process (PDP) is a living construct and is always the result of continuous learning and ongoing development based on known and new challenges. The strong market orientation of automobile manufacturers (Original Equipment Manufacturers or OEMs) and the increasingly fast reaction times that this requires mean that development times are growing ever shorter. At the same time, the rising degree of individualization in combination with exacting quality demands leads to great technical complexity. Moreover, the PDP must ensure effective networking between internal and external resources from the development stage onwards and integrate development partners and system suppliers.

As a rule, each automobile manufacturer has its own specific PDP, yet there are some basic commonalities that take on different shapes according to the company's philosophy and circumstances. There might be differences in the length of the concept phases, for example, or in the placement of individual design-freeze milestones.

Fundamentally, the overall PDP process is divided into main phases with milestones known as quality gates between them. As synchronization points, these quality gates are used to check the status of predefined criteria which, once fulfilled, trigger the approval of the preceding phase and the continu-

ation of the project. The PDP contains interfaces between development, project management, quality, procurement, production, and sales. Thus the PDP forms a detailed procedural model for mapping the simultaneous engineering process and, in terms of methodology, represents the ideal process for creating a vehicle.

### Pre-PDP and product definition

The pre-PDP step precedes the actual product development process and serves to flesh out the product idea and integrate pre-development topics in the project. The outlines are defined in a profile and work begins on a rough assessment of feasibility and the specification of requirements. In addition, the positioning of the product with respect to the competition and in the target markets is determined. Project management gets under way in this phase and establishes the project organization, rough scheduling and initial resource and budget planning.

In the product definition, the departments define their requirements of the product based on the profile. In addition to developing styling designs, this phase also includes analyses of the competition and elaborations of the concept. Ultimately, the result of this phase is a design for the overall vehicle, including the rough concept, the package, safety considerations, production technology, and aerodynamics values. Thus both technical objectives and an economic outline have been defined.

During the early phases of pre-PDP and product definition, the core processes take place under the aegis of the manufacturer. Porsche Engineering can provide technical expertise and advisory services for processes. The spectrum of services ranges from concept studies to concept evaluations and benchmark studies. Existing concepts are evaluated in terms of technical feasibility, decisions regarding producibility and production technology are made, and styling recommendations are presented. Porsche Engineering provides support in integrating long-term development trends in the concepts such as downsizing, e-mobility and lightweight construction, as well as modern assistance systems and connectivity options. Alternative concept proposals may also be developed.

In many cases, Porsche Engineering is involved in such pre-development and research projects because the customer lacks or has limited experience with a new technology and

the expertise in using it. Porsche engineers have a wide range of technological expertise in this area as well as many years of experience across the entire vehicle spectrum as well as in the non-automotive field.

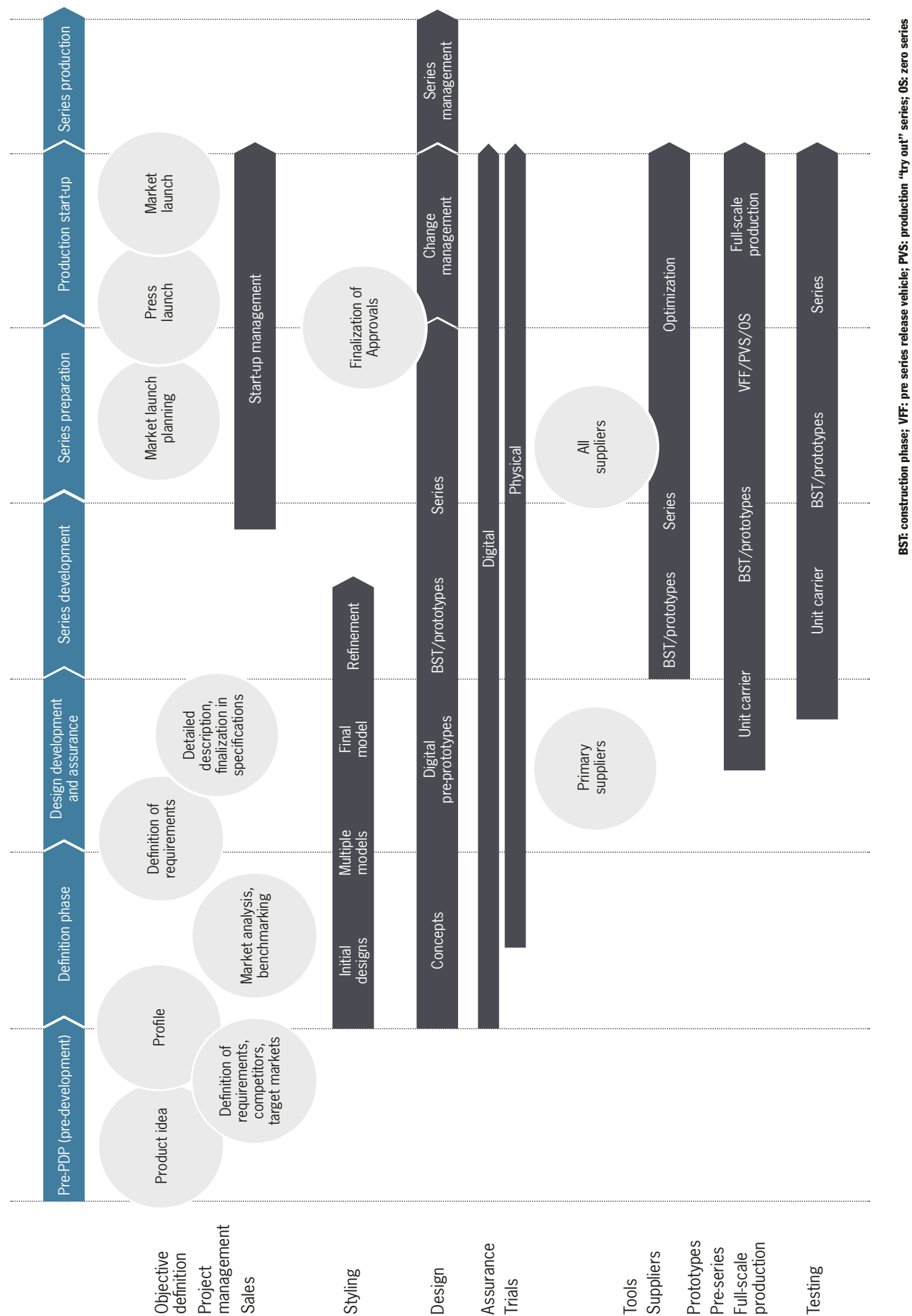
### Concept development and assurance

The concept development and assurance stage involves the design and production of digital prototypes as well as detailed planning and finalization in the specifications. Beyond simulation, initial testing with unit carriers takes place. Following selection of the final styling model, refinements begin that will continue into series production of the vehicle. Typical project requests in this PDP phase, as well as in pre-development projects, concern the development and creation of a demonstrator or prototype. The starting point is rough drafts or product profiles provided by the customer. Based on them, Porsche Engineering takes over all development processes from design to calculation and trials as well as the setup, application and testing. Moreover, all development-related functions such as procurement, logistics, and quality management are handled internally and contribute massively to the successful implementation of the project. Porsche Engineering can also count on reliable partners specialized in prototypes, limited-run, and pre-series. After assembly, the prototypes can be tested on test benches.

When a prototype is being created, many of the PDP processes are conducted in a concerted manner. Porsche Engineering has developed its own processes and systems to accompany and control the creation of prototypes. This includes not only devising and maintaining the bill of materials but also a multi-level approval system and an in-house system for test plans. But this is no immutable apparatus; instead, the entire system is designed to react flexibly to customer requirements and, if needed, to work together with customer systems.

### Series development

In series development, the creation of prototypes and the construction phase, the design of the series vehicles and the start of testing all occur in parallel. At the end of this phase, all suppliers have been selected and start-up management takes up its work to prepare the next phase. >



Schematic representation of the product development process

Like in the conceptual design phase, Porsche Engineering also frequently assumes responsibility for components and modules in this phase. This involves assuming responsibility for components from the concept and sample phases through the pre-series and on into series production. Associated with this task is responsibility for all interfaces between the different development areas as well as with procurement, production, logistics, quality, and sales. Moreover, they have the requisite skills from a process and methodology perspective, such as functional safety (FuSa), FMEA (Failure Mode and Effects Analysis), and tolerance management. With their well-founded knowledge of many customer-specific processes and systems, the engineers from Porsche Engineering can easily occupy an overarching role within the customer's development organization.

Responsibility for components can cover an entire field of application—for instance the complete bodyshell—or indeed the entire vehicle. It can also be highly specific, such as the development of a high-voltage battery or the use of innovative materials (see the article “Precisely Developed: Hybrid cross member made of fiber-reinforced plastic” on page 14). When it comes to testing the construction phase as well as pre-series testing, the Porsche testing grounds in Nardò in southern Italy represent the ideal complement to the development expertise in Germany, Prague and, since late last year, the new location in Shanghai.

### Series preparation and full-scale production

Series preparation involves moving closer to series production-readiness through a sequence of staggered pre-series. With the first vehicles in series and series-like facilities, the vehicle manufacturer not only stabilizes its production and logistics processes internally, but also externally as the entire process takes place throughout the supply chain as well.

When the run-up to series production is finished, the actual development activity is at an end and the work of the project organization as well as all development teams is complete. Emerging issues are handled by the series production team, which has already begun its work with the step-by-step hand-over and the finalization of approvals during the pre-series phase.

In the final two PDP phases, the development scopes are handed back and the core processes resume in greater concentration with the customer. Porsche Engineering remains active at this stage—in addition to continuing and finalizing development packages from earlier phases—in the industrializa-

tion process. The focal points are procurement and supplier management, quality management, production and logistics planning, as well as start-up management. This includes sampling inspection, checking series capability at the suppliers', FMEA workshops in the production field, developing equipment, controlling change management processes, as well as series management following the start of production.

### Conclusion

Porsche Engineering is well-versed in development work across a broad range of different contexts. Detailed processes and specifications are implemented with great expertise, often directly in the customer systems. At the same time, the engineers demonstrate great flexibility and creativity in developing custom solutions, both in terms of technology and process, even where the specifications are less precise. While the focus is clearly on the technology, when needed processes can be adjusted pragmatically to bring the projects to a successful conclusion.

In addition to development work with customer-specific PDPs, Porsche Engineering can also add elements to existing PDPs or develop them from scratch. Regardless of what type of development or the phase of the PDP that engineers are currently working on, the preceding and subsequent process steps are always taken into account, or otherwise incorporated into the overall process, in order to ensure smooth integration with the customer environment.

Porsche Engineering is always enhancing its own capabilities and expertise. Its ever-growing expertise in the field of simulation is perfectly in step with the increasing digitization and virtualization of PDPs. And the use of modules and platforms is an effective way to reduce development and procurement costs by increasing the number of shared components. ■