

# It's electric, it's complex, it's electromobility.

StreetScooter

As if the automotive product development process needed to get any more complex, now add the “electromobility” factor.

StreetScooter – a revolutionary electric vehicle rapidly taking shape – not only puts a new technological charge into the electromobility concept. Its crowdsourced design blends the expertise and innovations of nearly 30 collaborating suppliers.

Ask automotive executives what keeps them up at night and you shouldn't be surprised to hear this brief, but very telling reply:

“It's complicated.”

That, in essence, is what decision-makers from automotive OEMs and suppliers told researchers at RWTH University in Aachen, Germany when surveyed a few years ago. Findings were published in the 2007 report “Managing Complexity in Automotive Engineering.” The executive summary puts it this way: “Superior complexity management in the disciplines of variety management, technology management, and process management is a key factor to ensure sustained success for OEMs and tier-one suppliers.”

Per the study, variety management refers to the competitive demand to keep up with ever-expanding product lines, faster model changes, and more vehicle variations by region.

Growing just as quickly is the technological complexity of the cars. “The automobile today,” says RWTH Aachen Professor Günther Schuh, a lead author of the “Managing Complexity” study, “is as much the result of electronic and software engineering as it is a mechanical design. All three areas of technology must be efficiently integrated.”

In the face of such rapid varietal and technological change, the stresses on automakers' development processes – both within companies and among OEMs and suppliers – have similarly multiplied. It can be little surprise, then, that the automotive industry's leaders continue to up their investments in product lifecycle management (PLM) solutions.

"PLM is, in fact, a critical enabling technology for complexity management," says Professor Schuh. The sure evidence: RWTH Aachen enlisted PTC, the global provider of PLM software, to advise on the "Managing Complexity" survey.

"And now," Professor Schuh adds, "as if the vehicle development process needed to get any more complicated, automakers can toss 'electromobility' into the mix."

### Supplier-driven development

In the race to bring fleets of affordable, consumer-friendly electric cars to the world's roads, no automotive industry-dependent country wants to fall behind. And perhaps no single nation feels this urgency more than Germany, where over 20% of GDP directly traces to automobile development, production, and supply.

"It is not just the desire to have environmentally friendly cars and reduce dependency on fossil fuels," says Professor Achim Kampker, also of RWTH Aachen. "It is a matter of pure economic interest. Our future prosperity will depend upon electric vehicles."

Professor Kampker continues: "As transportation power increasingly shifts from internal combustion to electricity, it will be incumbent upon German automakers and suppliers to stay ahead competitively. There are literally millions of automotive jobs at stake here."

Electromobility not only adds to vehicle variety and technological complexity, it also shows the potential to transform automaking processes fundamentally. For a new electric car now taking shape, the traditional hierarchical approach – in which the OEM defines the concept, specifies the project, and oversees the work assigned to suppliers – has given way to what may best be described as a crowd-sourced development.

Professor Kampker explains, "It is the suppliers themselves who are driving the vehicle's design and production. They are collaborating as peers in a virtual enterprise."



Professor Achim Kampker of RWTH Aachen University, and CEO of StreetScooter GmbH with a design model.

#### Solution at a glance

The StreetScooter initiative – led by RWTH University in Aachen, Germany – aims to create a family of consumer-friendly electric cars through a network of small to medium-sized suppliers. PTC's Windchill® is the PLM platform. This lets the suppliers:

- Collaborate effectively on the vehicle's development in a virtual enterprise.
- Contribute to the vehicle's design in a modular building-block approach.
- Break down barriers between the car's mechanical, electronic, and software designs.
- Quickly see the impact of design changes wherever they affect the vehicle.
- Continually work with the most up-to-date product design and process data.
- Integrate product and process data management to enhance design flexibility.
- Systematically leverage the team's learning to optimize the vehicle's performance.

**Project status:** StreetScooter is on track to deliver 10 functional prototypes by December 2011. Longer-term, the project aims to have tens of thousands of mass-market EVs on German roads within the decade.

The experimental laboratory for this concept is StreetScooter, a bold new EV initiative led by RWTH Aachen. From the start, 19 Germany-based automotive suppliers have been stockholders in the project –10 of them combined as a single stockholder in a joint venture. Ten other suppliers have since signed on as strategic partners, lending their own specialized expertise. The team manages the project using PLM tools from PTC.

A commercial entity, StreetScooter GmbH, has been formed to coordinate the suppliers' work on the vehicle. Professor Kampker is the company's CEO. He says, "StreetScooter sets out for nothing less than to revolutionize the electric car and its development."



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Professor Guenther Schuh  
Chair of Production Systems, RWTH Aachen University

### Clean-sheet concepts

The StreetScooter project's goal is to create a family of electric vehicles for urban traffic that can be effectively produced by a network of supplychain partners without the need for sustained government funding.

"The German government is not directly involved," Professor Kampker says, "though our project has been highly influenced by government direction. The National Development Plan for Electromobility aims to put one million electric vehicles on Germany's roads by the end of this decade. It is a goal we hope to help the country meet."

StreetScooter is a regional initiative, mainly focused in Germany and surrounding Central European nations. The project's partners are mostly SMBs (small and medium-sized businesses), rather than OEMs or major suppliers. "This," says Professor Kampker, "is in keeping with German industry's historical reliance on small family-owned enterprises."

StreetScooter thus brings new forces to the front lines of EV development; it also offers a fresh EV strategy. As Professor Kampker notes, major automakers already offering electric cars have to date focused on adapting the designs of conventional combustion-engine vehicles. "The problem," he says, "is that converting these vehicles to electric drive trains has demanded cost premiums unacceptably high to most consumers – about €10,000 per car."

Plus, driving performance and passenger comfort remain compromised in these early EVs. Air conditioning alone places heavy additional load on the cars' batteries.

"New clean-sheet electromobility concepts are clearly required," says Professor Schuh. "But many of the concept EVs we have seen to date focus on extreme driving performance or eccentric designs. They have ignored the basic requirements for a mass-market car."

Not so with StreetScooter. Its development team seeks to introduce an affordable electric vehicle that can compete with conventional compact cars in every area of performance, comfort, safety, and reliability – and that can be serially produced at a profit.

StreetScooter's modular product architecture is key to making the concept work. Interfaces between modules let suppliers continually enhance the car's design with the newest innovations in their areas of specialty. They add features in building-block style.

Through this "learning approach," says Professor Schuh, the StreetScooter team "not only leverages the latest technologies, but also discovers how to better integrate them." He adds, "Learning builds upon learning in a dynamic, interdisciplinary way. We are testing new forms of collaboration and setting new standards for automotive development."

### Product & process integration

The project's early momentum appears to bear out the value of this distinctive development style. StreetScooter is on target to unveil its first functional prototype at the International Motor Show (IAA) in Frankfurt, Germany in September 2011. Ten more prototype vehicles should be on German roads by the year's end.

Yet, as promising as the StreetScooter initiative is proving to be, the widereaching supplier collaboration at its heart has added new complexity to the development process. "If anything," says Professor Kampker, "effective PLM is even more central to our success."

PTC's industry-leading Windchill software provides the PLM resources for coordinating and streamlining the work of the StreetScooter's contributors.

To put the PLM platform in place, RWTH Aachen worked with consultants in PTC's Automotive Center of Excellence – part of

#### Fast facts on StreetScooter

- StreetScooter GmbH is the commercial entity created to coordinate the supplychain partners' collaborative work on the vehicle's development.
- The project was initiated, and continues to be led, by RWTH Aachen University, Germany, where some of the world's foremost authorities on managing complexity in automotive product development are found.
- A network of more than 50 small to medium-sized suppliers collaborates on the StreetScooter's design. Each contributes specialized technological expertise.
- Some of the suppliers have 20,000+ employees; others employ fewer than 10.



Effective PLM is central to our success. It provides the knowledge base – a single source of truth – for all who share in bringing the StreetScooter to life."

Professor Achim Kampker of RWTH Aachen University, and CEO of StreetScooter GmbH

the company's iCenter support team – to explore use cases for the vehicle and build the basic data model for the StreetScooter's design. This involved applying and adapting out-of-the-box vehicle data structures. What has resulted is a complete digital prototype of the StreetScooter concept, from interior to exterior and including the car's engine, powertrain, suspension, and tires.

The StreetScooter team uses a PLM platform powered by PTC's Windchill technology to define and keep track of suppliers' access rights and roles in the design project. PLM applications center on BOM and change management. When there is a change request, all involved can immediately see the impact, wherever it is felt in the design. Innovations in one area instantly relate to others. Suppliers use PTC's Creo™ Elements/View™ software to visualize these effects.



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The Windchill platform handles all product data, regardless of what CAD software the suppliers use. "It is a true multi-CAD data management environment," says Professor Kampker. "This lets us break down the silos between mechanical, electronic, and software designs. We are developing the full vehicle with smooth integration of all three disciplines."

Perhaps even more ambitiously, the StreetScooter development team has looked to PLM to help tighten their integration of product design and production decisions. This is creating significant new possibilities for the vehicle.

Professor Kampker explains: "Traditionally, many automotive design decisions have been based on batch sizes. That is, some technologies could apply only if particular levels of production quantity were reached. But PLM lets us explore every alternative."

As evidence, Professor Kampker cites this example: "We are using the PLM tools to help prove out our use of tubular space-frame components. These are less expensive to produce than traditional stamped and molded parts. However, until now, the technology seemed limited to small-batch motorcycle manufacturing."

The impact on StreetScooter: "Using space-frames should help us keep the car's price affordable," says Professor Kampker.

### A development like no other

From practically every perspective – product, production, and process – StreetScooter is a new vehicle development like no other. Its exceptionally wide field of collaboration brings an especially high level of complexity. Yet the contributing partners seem more than up to the challenge. Confidence stems from their smart use of PLM.

Professor Kampker sums it up: “We have built the foundation of design and process intelligence essential to our project’s long-term success. PLM provides the knowledge base – a single source of truth – for all who share in bringing the StreetScooter vision to life.”

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