Next generation parametric design

Jeroen Coenders, White Lioness technologies, Van Diemenstraat 118, 1013 CN Amsterdam, The Netherlands, jeroencoenders@white-lioness.com

Parametric and associative systems already have a long history in design modelling (Peters et al, 2013). Similarly to the adoption of other types of software applications such as Finite Element Method application initially parametric design was applied by the few who could develop such applications themselves by making use of (textual) programming.

However, since the introduction of GenerativeComponents (Aish, 2005), Grasshopper (McNeel, 2008) and Dynamo (Autodesk, 2016) the large scale adoption in the architecture, engineering and construction practice has taken off. More architects, designers and engineers are now able to adopt parametric design in their projects without requiring programming skills. When this new generation of design systems emerged initially it could be observed that the focus of use of these systems was mainly focussed on the expression of geometry rather than other aspects of design, engineering and construction. This could for instance be observed at the outcomes of the SmartGeometry conferences (SmartGeometry, 2019) which have been pivotal in the experimentation with these systems as well as the growth of their popularity. However, since the beginning of the emergence of these systems the author has been part of a small group of people who valued these systems rather for their ability to express design logic (rather than just the geometrical subset of the total design logic) without having to write textual programming code to express this logic.

This interest followed from a research project where the author developed a generalised computational framework for form finding and optimisation algorithms where the user can programmatically express the generation and evaluation logic part of these processes (Coenders, 2004). However, the limitation of this framework was that the user had to still write textual programming code which limited adoption by practitioners who did not possess these skills; the majority.
At the time the aforementioned parametric and associative technology was just emerging and was not very suitable for integration with the framework. Following this result, the author developed a novel parametric and associative system which generalised concepts from various other systems combined with novel concepts in a single conceptual system and which was able to express design logic through visual programming overcoming the limitations of textual programming (Coenders, 2011).

Although the author has developed (textual) programming skills since the age of nine, when the author joined engineering firm Arup to adopt computational design methods the realisation quickly came that textual programming was not easy to adopt for everybody involved in the architecture, engineering and construction industry and therefore the adoption of such technology will always be limited. This is a shame because adoption of parametric design technology is the gateway to many other pieces of computational design technology which can greatly benefit the industry and therefore society, such as automation and optimisation. Because parametric design technology allows designers to express and manipulate their own design logic and adopt this in their design processes and increasing number of automated equivalent processes, the designers tend to trust this technology more than other systems which often are experienced as a blackbox by the designer. Trust in the methods employed is key for adoption of computational systems by designers (Coenders, 2011).

Therefore the author would like to propose that the accelerated adoption of systems such as GenerativeComponents, Grasshopper and Dynamo over the previous textual programming approaches to parametric design has been caused by their ability to express design logic without textual programming code but by the use of visual programming methods.

However, in current practice again barriers can be observed. It can be found that new limitations have emerged which need to be overcome to move towards the vision to commoditise and democratise advanced (design) technology.

The author would like to propose that we are now on the brink of another generation of parametric design technology or perhaps multiple novel generations which are emerging in parallel.

This paper provides an introduction to two sessions at the international symposium of the International Association for Shell and Spatial Structures on the Next Generation of Parametric Design where an overview will be given of the first glimpses which can be observed towards the novel generations. Furthermore, one of these latest developments in the next generations of parametric design as well as the ability and a number of use cases from practice of a next generation parametric system developed by the author and his colleagues called Packhunt.io which uses a no-code approach (visual programming) to modelling and configuration to express design logic and the related processes to control the design, engineering and production to build the next generation of parametric models, Building Information Models and Digital Twins will be discussed.

This technology, called Packhunt.io, can be easily adopted by architects, engineers and designers without access to specialised design systems to build self-service automated processes, (online) configurators, Digital Twins (parametric BIM) informed by physical measurements (sensors) and other types of design feedback, systems for optimisation and exploration and 3D visualisation. The user can build her own application which is tailored to the requirements and preferences of the user which helps the user to support her own processes. This system utilises a cloud-native approach to harness the advantages of cloud technology, such as scalability, accessibility and availability. This means that the system can handle data and models larger than a single machine, process faster than single machine systems, is accessible from anywhere in the world through a web browser and is always available to deliver data to which is crucial for sensor-data delivery and Internet of Things scenarios.

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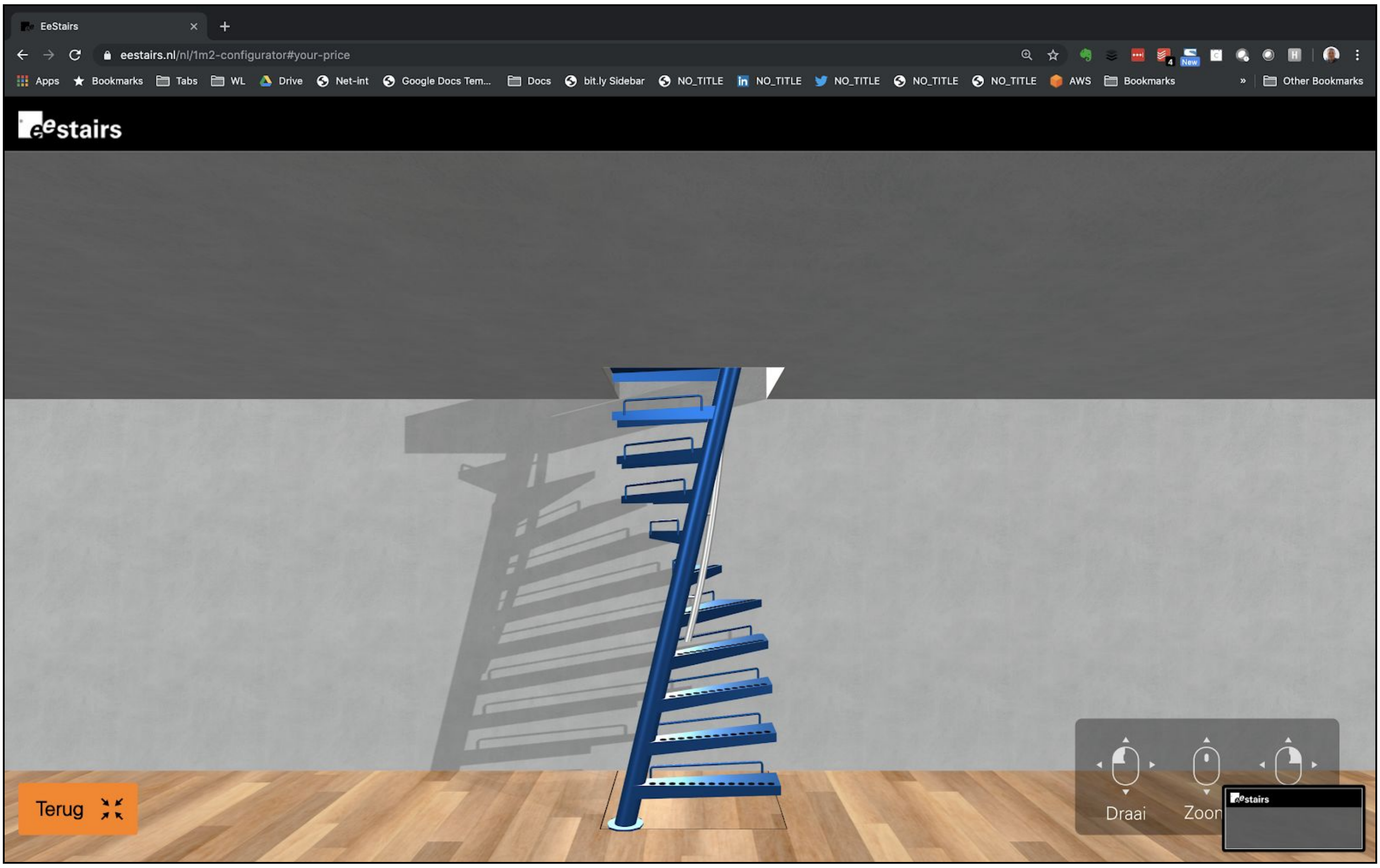

Figure 1. Example of an online parametric product configurator which demonstrates a full process from online sales on a website to production of the final product

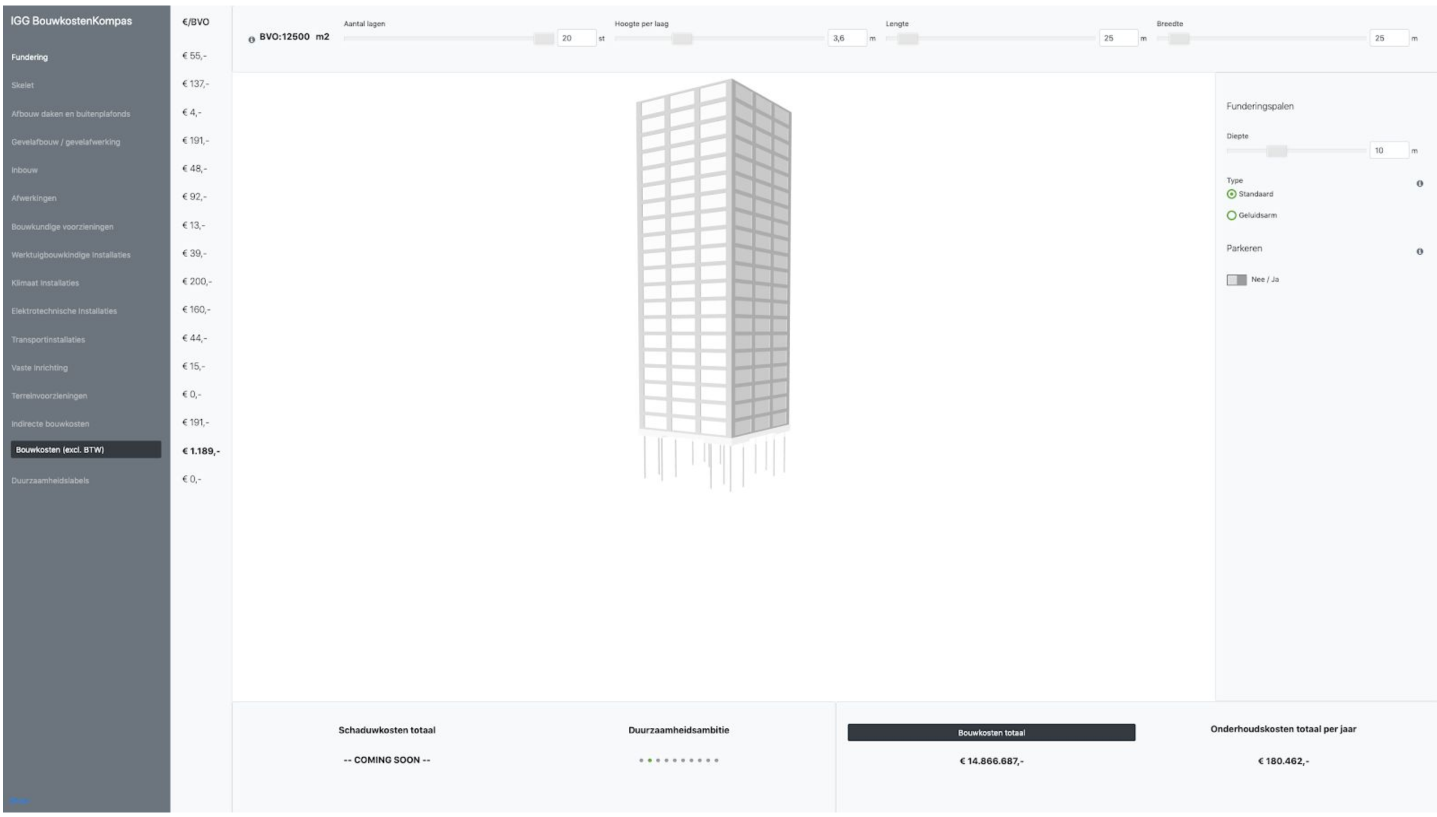

Figure 2. Example of a novel design platform built with the Packhunt.io technology