Journal of Engineering and Technology Management 64 (2022) 101685

Contents lists available at ScienceDirect

Journal of Engineering and Technology Management

journal homepage: www.elsevier.com/locate/jengtecman

On the nature, origins and outcomes of Over Featuring in the new product development process

Giacomo Marzi [1]

University of Trieste, Department of Management, Mathematics and Statistics (DEAMS), Piazzale Europa 1, 34127 Trieste, Italy

ARTICLE INFO

Keywords:
New product development
Product design
Product features
Requirement engineering
Project management

ABSTRACT

Developing new products and services beyond what is required by the needs of users, market demand and the resources of companies ranks among the top 10 risks leading to new product development (NPD) failures. This study defines and refers to this multifaceted phenomenon as 'Over Featuring' (OVF) to group different forms of excessive product development, from scope creep to overspecification and feature creep. The classification and theoretical development of the various forms of OVF is proposed, also origins and adverse outcomes, such as feature fatigue, are explored. Stage-Gate and Agile approaches are discussed in the light of the OVF phenomenon.

1. Introduction

A long time ago, Horace said '*Est modus in rebus*'.[2] Today, the search to win over increasing competition and need to gain a competitive edge in the market in timely fashion require companies to produce a continuous inflow of new-to-the-world products, new services and an ever-evolving product portfolio (Christensen and Bower, 1996; Marzi et al., 2021; Wouters et al., 2011).

However, the critical task of creating a competitive position by developing something new lies in the effective management of the uncertainty and fuzziness that are inherent to the innovation process (Christensen and Bower, 1996; Yu et al., 2010). Uncertainty comes from both exogenous and endogenous sources and plays a crucial role in the success of the innovation and new product development (NPD) processes. Exogenous sources include shifting customer preferences, competitors' strategic moves and nascent technological trajectories, while endogenous ones are, for example, developers' creative responses to discoveries during the project or the co-evolution of technical solutions in the interacting product components (Antioco et al., 2008; Burke, 2013; Gross et al., 2015; Wouters et al., 2011). As a result, managers, project managers, engineers, and developers have to make decisions with scarce information, high ambiguity and a vague overview of market needs that could favour the emergence of several unexpected states of NPD projects (Antioco et al., 2008; Burke, 2013; Coman and Ronen, 2010). At the same time, the increasing need for product distinctiveness, continuous technological developments and rapid changes in customers' preferences are pushing companies to develop

E-mail address: giacomo.marzi@deams.units.it.

[1] ORCID: 0000-0002-8769-2462.

[2] The Latin expression of the Roman poet Horace (65 BCE–8 BCE) calls for wise moderation and a sense of measure to avoid any type of excess. Specifically, Horace warns us to take care not to run into too much or too little and to adopt the equilibrium required by the situation (Harrison, 2007). Horace's complete sentence is *Est modus in rebus sunt certi denique fines, quos ultra citraque nequit consistere rectum*, which can be translated as 'There is an optimal condition in all things with precise boundaries beyond which one cannot find the right thing'. The sentence can be found in Horace, Satire (1, 1, 106–107), 35 BCE. Western mythology offers several other pedagogical tales on this topic, such as Aesop's fable *The Fox and the Grapes* (Gross et al., 2015), or the myth of Icarus (Coman and Ronen, 2010).

https://doi.org/10.1016/j.jengtecman.2022.101685
Received 23 December 2021; Received in revised form 25 March 2022; Accepted 16 April 2022

products with more and more alluring characteristics, able to seduce consumers by offering performances and features beyond what the latter need (Antioco et al., 2008; Coman and Ronen, 2010; Thompson et al., 2005; Wouters et al., 2011).

Starting from these premises, the present study defines and classifies as 'Over Featuring' (OVF) a set of tendencies that can harm the success of an NPD process, spanning the fields of innovation management, research and development (R&D) management, engineering and design (Bianchi et al., 2019; Shmueli and Ronen, 2017). The term OVF comprehends a number of different conditions which can happen anywhere along the NPD process, during its ontogenesis, when a product or service is developed beyond what is needed by the users, market or plans as well as what is feasible within the company's resources. The outcome of OVF is a pathological condition of the NPD process manifested through a variety of adverse outcomes on product usability and quality and project performance (Bianchi et al., 2019; Bjarnason et al., 2012; Coman and Ronen, 2010; Shmueli and Ronen, 2017).

The magnitude of risk associated with OVF is so pervasive that even the National Aeronautics and Space Administration (NASA) listed the inclusion of excessive features among the top 10 risks of failure for development projects (Landis et al., 1992, pp. 98–128). Several sound examples of the effects of OVF on NPD projects are available in everyday experience. Mercedes-Benz developed, delivered and later removed around 600 non-essential features from its cars as they were the direct cause of several malfunctions to electronic parts, lack of usability, increased need for after-sale support and complaints from customers (Rust et al., 2006). BMW series 7 included the iDrive system, which proposed about 700 capabilities requiring multifunction displays and multi-step operations. The complexity of the iDrive system forced BMW to include an instruction manual, which was thought necessary whenever a valet parker took the car (Rust et al., 2006). From 2010, Apple included in its product the Retina display to attract new customers and showcase a distinguishing feature, claiming that Retina has more resolution than the human eye can perceive (Edwards, 2010). Although the Retina has driven innovation in the entire display industry, a resolution beyond what is perceivable by human eyes brought several inconveniences, from the higher costs and complexity of the devices' architecture to the tangible battery and consequent decreased battery life (Edwards, 2010; Liu and Yu, 2017).

Hence, OVF can manifest in different forms and at different levels, through deliberate decisions or unconscious behaviours at different organisational strata. OVF has different facets, from the steady increase of the project's scope (scope creep) to the continuous inflow of additional features when the product is still in development (overdesign and feature creep), often contradicting the ethos of the KISS principle, and more broadly, the Occam's razor (Griffin and Somermeyer, 2008). The consequences of OVF are numerous and frequently become a steep price to pay. Project delays, budget overruns and user difficulty with excessively featured products, namely feature fatigue, are common outcomes in OVF-affected NPD projects (Rust et al., 2006; Stock, 2011; Thompson et al., 2005; Verkijika, 2021).

However, despite the magnitude of the OVF phenomenon, it has received little attention, especially outside the software development domain (Shmueli and Ronen, 2017), and recent literature has only highlighted the relevance of OVF to physical products and services (Cesaretto et al., 2021; De Giovanni, 2019; Jain, 2019; Liu and Yu, 2017).

Consequently, the nature, origins and outcomes of OVF remain understudied and have not been appropriately recognised and encompassed in the NPD literature (de Vasconcelos Gomes et al., 2021; Gyimah et al., 2019). An analysis of the available studies showed that the body of knowledge related to OVF is poorly theoretically developed, and terminological confusion is widespread.

Therefore, there are consistent theoretical and empirical gaps that need to be addressed and brought to the attention of scholars, managers and practitioners through the following research questions: (1) What are the different forms of OVF, and how do they evolve during the course of the NPD process? (2) What are the antecedents and outcomes of OVF? (3) Where and when does OVF manifest during the NPD process, in light of the two main NPD management approaches, namely Stage-Gate and Agile?

To address these gaps, the present paper analyses and unpacks the OVF literature by focusing on its antecedents and effects, reconnecting these with the latest available studies on the NPD realm, proposing a theoretical model capable to clarify the phenomenon of OVF comprehensively. In doing so, this study first presents an integrative and inclusive overview of the literature which can elucidate the interconnections, evolution and effects of the various forms of OVF (Cronin and George, 2020). Grounded on the results emerging from the review, a conceptual development of OVF is then proposed, allowing the exploration of the interconnection among the various facets of OVF and serving as a springboard for future development of the topic (Corley and Gioia, 2011).

The results which emerged from the present analysis highlighted the existence of different forms of OVF at different stages of the NPD process, while a large variety of outcomes and antecedents of OVF has been identified and classified. Moreover, the present study sheds light on the growing phenomenon of OVF by offering a comprehensive taxonomy of it which clusters the different terms currently in use across different fields. The exploration of OVF has been approached with a clinical-like lens by highlighting its different facets and considering them all in a single, general model that shows the pathological state of the NPD process resulting from OVF.

It has been widely recognised that the management of the NPD process and its uncertainty have long posed problems for scholars and practitioners in regard to the difficulty of forecasting user need and market demand during the NPD process, especially when the time span from idea to market launch is lengthy (Antioco et al., 2008; Bianchi et al., 2020; Salvato and Laplume, 2020). The NPD process has been managed via Stage-Gate or Agile processes, which are based on two opposite tenets: either control uncertainty or welcome it (Bianchi et al., 2020). In this regard, the problem of OVF often escapes the boundaries set by the Stage-Gate or Agile method, creeping silently through the various phases of the development process. Thus, the present study lastly proposes an analysis of when and where OVF could manifest in the two common NPD process management approaches.

In the following section, the methods for the study are presented. The third section proposes the taxonomy and reclassification of OVF, while the fourth analyses the pathological structure of OVF, its antecedents and its outcomes. Section four also proposes an integration of OVF in the Stage-Gate and Agile frameworks for NPD. Finally, the conclusions and limitations are presented, along with an agenda for further development of the field.

2. Methods

As the main goal of this paper is to offer a theoretical development of OVF, the high fragmentation of the literature on the topic required the use of a structured approach to collect, merge, interpret and recompose the puzzle formed by the available studies. While the present section depicts the key steps of the conceptualisation process, Appendix A offers additional methodological details and the full list of material included in the present study.

A combination of best practices from literature reviews (Cronin and George, 2020; Marzi et al., 2021; Tranfield et al., 2003) and theory development practices (Corley and Gioia, 2011; Wacker, 1998) was applied. The use of the integrative review approach (Cronin and George, 2020) as a guiding baseline to analyse, interpret and expand the extracted material allowed a summary of the existing state of knowledge on the subject, connecting contributions nested in disparate paradigms and fields of studies. In collating, summarising and theorising the concept of OVF, the suggestions made by Corley and Gioia (2011) were applied. In particular, the retrieved material was decomposed and reorganised following the lens of the NPD process, specifically the Stage-Gate and Agile approaches (Bianchi et al., 2020; Cooper and Sommer, 2016). The problematisation of OVF traces the various phases of the NPD process, namely scoping, specification, development and launch (Bianchi et al., 2020; Cooper and Sommer, 2016; Shmueli and Ronen, 2017). Furthermore, the concept of OVF was constantly reconnected and evaluated in the light of the seminal works on the topic by Bjarnason et al. (2012), Coman and Ronen (2010), Shmueli and Ronen (2017) and Thompson et al. (2005).

The first step in the process outlined above was a wide search of the major databases (Scopus, Web of Science, EBSCO, Google Scholar) using a set of different research terms related to OVF, grounded on the approach proposed by Shmueli and Ronen (2017). The database search was performed iteratively during the development of the present study to ensure the inclusion of the most up-to-date literature available. The first query was made on 2 March 2020. Additional queries to update the database of included studies were made on 1 October 2020, 3 November 2021 and 21 March 2022.

Next, the material extracted were collated and compared (Cronin and George, 2020; Marzi et al., 2021). Only studies referring to excessive development in NPD were included by combining the definitions of the various facets of OVF which arose from previous studies (Bianchi et al., 2019; Bjarnason et al., 2012; Buschmann, 2009, 2010; Coman and Ronen, 2010; Elliott, 2007; Shmueli and Ronen, 2017; Thompson et al., 2005). Through the first step, 39 studies directly related to OVF were identified.

As contributions to the OVF field are sparse, after all the material extracted from the first step was read, a bi-directional analysis of the citations was performed by looking at all the references citing as well as the references cited in the first batch of 39 studies, with the aim of catching possible missing material (Cronin and George, 2020). Grey literature, including practitioners' contributions, editorials and technical communications discussing OVF, were included (Adams et al., 2017). This step led to the inclusion of 20 additional studies for a final count of 59 documents.[3]

3. A taxonomy of Over Featuring

The first sign of research and practitioners' interest in OVF emerged when Paul Abrahams, president of the Association for Computing Machinery (ACM), warned of the risk of trying to anticipate and account for all possible future software extensions by overspecification (Abrahams, 1988) . At the same time, Bohem and Papaccio (1988) posed the same question in terms of the costs of over-specified products.

A broader interest in OVF occurred some years later, when scholars identified the development of highly featured products as a response to increasing competition in technology-driven industries (Boehm et al., 2000; Christensen and Bower, 1996; Davis and Venkatesh, 2004). Later, the uncontrolled extension of projects' scope captured the attention of scholars and practitioners, as it highlighted the risk of exposing the entire NPD to failure, low-usability and unnecessary complexity (Boehm and Turner, 2005; Chen et al., 2009; Dean Hendrix and Schneider, 2002; Knight and Robinson Fayek, 2002; Ropponen and Lyytinen, 2000).

In 2005, a crucial step toward defining the outcome of excessive feature-richness was made by Thompson et al. (2005), who defined feature fatigue, while theoretical improvement on the user-centric perspective of feature-rich products was made in the late 2010s (Buschmann, 2009, 2010; Choi and Bae, 2009; Coman and Ronen, 2010; Gil and Tether, 2011; Gill, 2008; Han et al., 2009).

Grounded on these previous developments, since 2010 the field of OVF has witnessed further theoretical and empirical expansion under the lens of uncertainty and decisional biases, mostly from the field of software development (Bjarnason et al., 2012; Shmueli et al., 2015, 2016; Shmueli and Ronen, 2017).

More recently, a set of experimental studies which aimed to empirically asses the magnitude of OVF was published, allowing for a more comprehensive understanding and characterisation of the phenomenon (Bianchi et al., 2019; De Giovanni, 2019; Garcia et al., 2019; Gregori and Marcone, 2019; Jain, 2019). The literature also explores the role of features in generating overcomplexity for users and actors involved in the NPD process (Cesaretto et al., 2021; De Giovanni, 2020; Delpechitre et al., 2019; Eytam et al., 2017, 2020; Verkijika, 2021).

However, the multidisciplinary nature of OVF, together with the absence of a generalised theoretical framework, has caused the proliferation of terms with similar meanings. Thus, the first requirement for a comprehensive and unambiguous development of OVF starts with a terminological and conceptual reclassification of OVF's nomenclatures across various fields, from product to software development.

[3] As this study is single name-authored, in order to doublecheck the validity and reliability of the retrieved data, two scholars independently checked their accuracy (Cronin and George, 2020; Marzi et al., 2021; Tranfield et al., 2003). The responses were positive and confirmed the reliability of the method and execution.

Table 1
A taxonomy of OVF.

	Term	Definition	Synonym (s)	Main References
Beyond needs excess (BNE)	Overspecification	'Defining product or service specifications beyond the actual needs of the customer or the market' (Ronen and Pass, 2008, p. 162)	Over-requirement[a]; Overengineering[b]; Gold-plating[c]; Bells-and-whistles[c]; Flexibilitis[d]; Overshooting	Bianchi et al., 2019; Boehm and Papaccio, 1988; Buschmann, 2010; Coman and Ronen, 2010; Shmueli et al., 2015
	Overdesign	'Developing products or services beyond what is required by the specifications and/or the requirements of the customer or the market' (Ronen and Pass, 2008, p. 162)	Overengineering[b]; Gold-plating[c]; Bells-and-whistles[c]; Performitis; Flexibilitis[d]	Allen et al., 2019; Buschmann, 2010; Christensen and Bower, 1996; Coman and Ronen, 2010
Beyond plans excess (BPE)	Feature Creep	'Changes in features while a product [or a service – a.n.] is still in development' (Elliott, 2007, p. 304)	Feature bloat; Requirements creep	Choi and Bae, 2009; Damian and Chisan, 2006; Davis and Venkatesh, 2004; Elliott, 2007; Rust et al., 2006
	Featuritis	'Tendency to trade functional coverage for quality – the more functions and the earlier they're delivered, the better' (Buschmann, 2010, p. 10)	Feature bloat	Buschmann, 2010; Elliott, 2007; Hamilton et al., 2017; Rust et al., 2006
	Scope Creep	'Steady increase of the system's [or project's – a.n.] scope' (Buschmann, 2009, p. 68)	Mission creep; Requirements creep	Buschmann, 2009; Chen et al., 2009; Choi and Bae, 2009; Gil and Tether, 2011; Knight and Robinson Fayek, 2002; Schmidt et al., 2001
Beyond resources excess (BRE)	Overscoping	'Setting a [project's – a.n.] scope that requires more resources than are available' (Bjarnason et al., 2012, p. 1107)	Scope overload	Bjarnason et al., 2012; Shmueli et al., 2016

'a.n.' stands for 'author note'.
[a] The term 'over-requirement' is mostly used in the software development realm as a synonym of overspecification, even if there is a difference between requirements and specifications. 'Requirement' refers to what the user needs, while 'specification' refers to how the software fulfils the user needs.
[b] Overengineering is a general practitioners' term to describe various facets of OVF. Overengineering can refer to a product with a very broad set of functionalities, offering greater performance than requested or having an unnecessary technical flexibility to anticipate future technology trends. It can manifest during the specification phase or during the design and development phase. In practice, it has been used interchangeably to describe overspecification or overdesign.
[c] Bells-and-whistles is a form of overspecification or overdesign aimed at including fancy features to attract customers (Ropponen and Lyytinen, 2000), sometimes named gold-plating (Boehm and Papaccio, 1988).
[d] If the product is over-specified or over-designed, there is an intention to add extra but unneeded architectural flexibility, such as 'just-in-case' functionalities.

Hence, Table 1 revises and expands the classification proposed by Shmueli and Ronen (2017) for software development. It proposes an updated taxonomy of the terms used by both scholars and practitioners dealing with OVF in the entire field of NPD, suggesting and classifying different forms of OVF and further detailing the characteristics of each term. OVF is grouped under the three major categories of 'Beyond Needs excesses' (BNE), 'Beyond Plans excesses' (BPE) and 'Beyond Resources excesses' (BRE) originally proposed by Shmueli and Ronen (2017) for software development.

3.1. *Exploring beyond needs excess (BNE)*

BNE refers to specifying, designing and developing products and services beyond the current needs of the customers or the market. A product or service suffering BNE is loaded with superfluous features offering a number of functionalities and/or better performance levels than needed (Bianchi et al., 2019; Coman and Ronen, 2010).

Within the BNE category, overspecification usually occurs during the initial stages of concept and specification definition, when additional features, out of the initial scope of the project, are added to extend potential uses (Allen et al., 2019; Coman and Ronen, 2010; Wouters et al., 2011; Yu et al., 2010). Overspecification also serves as a padding – a buffer – against the uncertainty of the NPD process by including unnecessary characteristics to anticipate possible future trajectories or market trends (Allen et al., 2019; Bianchi et al., 2019; Coman and Ronen, 2010; Shmueli et al., 2015). Moreover, during the specification process, marketing departments usually push to include nice-to-have features aimed at alluring customers and increasing the market appeal of the product or service (Hamilton et al., 2017; Rust et al., 2006; Thompson et al., 2005).

Overdesign is similar to overspecification. It shares most of overspecification's characteristics but occurs later, when features not included in the scope of project are added during the development phase. Like overspecification, overdesign can be used to create a buffer to avoid later re-design of the product or service (Allen et al., 2019). In such a case, numerous features are partially designed and implemented, then later removed in future upgrades of the product or service. Notably, Allen (2019) showed that in a highly complex manufacturing environment, overdesign can be a complement to modularity and an alternative to re-design if the number of features is meticulously controlled and evaluated.

3.2. *Exploring beyond plans excess (BPE)*

BPE refers to the tendency to add features by continuously deviating from the plans, specifications and scope during the project's execution phase. BPE differs from BNE as it mostly manifests when the features are already planned and specifications are also 'frozen' (Bianchi et al., 2019; Elliott, 2007).

Within the BPE category, feature creep and scope creep are the most common forms of OVF. Although some authors considered these two terms to be synonyms (Chen et al., 2009; Elliott, 2007), recent studies have shown that feature creep and scope creep involve two different aspects of excessive development (Bianchi et al., 2019; Buschmann, 2009; Chen et al., 2009). The first is limited to the features, with several being added or changed during the development process. Feature creep diverts the project from the 'optimal' set of features planned to reach the scope of the project (Thompson et al., 2005). Scope creep, on the other hand, sees the entire project involved in constant, uncontrolled extension and revision of the scope of the project itself (Ajmal et al., 2021; Buschmann, 2009).

Scope creep and feature creep are often connected (Buschmann, 2009). When the scope of a project steadily increases because of scope creep, additional features are requested to address the new scope, generating, in turn, feature creep as a cascade effect (Davies et al., 2016; Gil et al., 2006; Gil and Tether, 2011).

Finally, 'featuritis' manifests as an escalation of demands for additional features to cover a broader set of users. The escalation happens in a short time during the development process, especially in the later stages of development (Buschmann, 2010; Eliëns et al., 2018; Repenning, 2001; Schmidt and Calantone, 2002). Featuritis inevitably affects the features' value, as more and more features are added at the expense of quality (Buschmann, 2010).

3.3. *Exploring beyond resources excess (BRE)*

BRE explicitly refers to OVF involving the scope of an NPD project by setting, usually before the start of the development process, such scope beyond the limits of project or company resources (Bjarnason et al., 2012; Shmueli et al., 2015).

BRE only includes Overscoping, which mostly originates in a fast-moving and market-driven environment when unfocused project goals, lack of communication and lack of developers' involvement during the scoping phase push the entire project to an excessive extension of the scope, beyond the resources allocated for the project (Bjarnason et al., 2012).

Overscoping typically begins with unrealistic expectations about the project, mostly related to budgets and schedules. Sales staff frequently propose delivering unrealistic features without considering the time needed for development (Bjarnason et al., 2012). Irrational behaviours, together with poor project management practices, promote the bloating of a project's scope in relation to the resources available for it (Schmidt and Calantone, 2002).

Overscoping could also happen during the initial development phase, if the entire scope of the project is revised, taking on similar characteristics to scope creep (Bjarnason et al., 2012). However, while overscoping and scope creep could appear the same, Bjarnason et al. (2012, p. 1108) use the expression 'biting off more than you can chew' to clarify that overscoping is a rapid increase of the scope

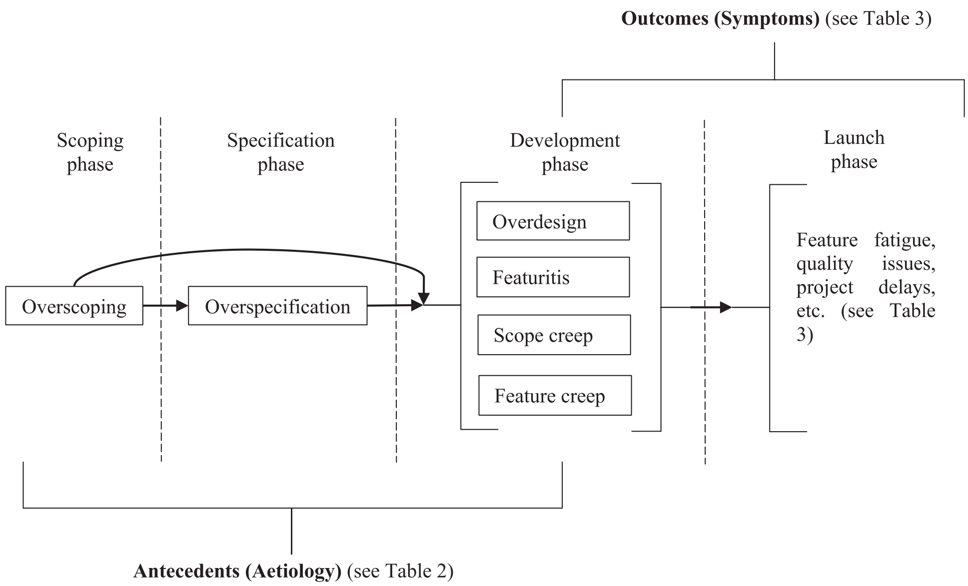

Fig. 1. A conceptual model for OVF.

while scope creep is a steady and slow increase during the project execution.

4. The nature of Over Featuring

While the previous section serves as a preamble to the theoretical development addressed in the next section, it is worth noting that previous studies on OVF have explored it as a series of separate and independent phenomena. However, delving into the literature reveals that they are rather highly interconnected, reinforcing each other and causing a cascade of effects throughout the entire cycle of the NPD process (Bjarnason et al., 2012; Buschmann, 2009, 2010). Next, OVF is analysed as a comprehensive and interconnected status of the NPD process, integrating the findings of the literature with the aim of proposing a theoretical perspective on the evolution of OVF, its antecedents and its outcomes.

Looked at in terms of how it manifests, OVF presents a structure that reflects a human disease (Bianchi et al., 2019; Coman and Ronen, 2010). OVF manifests as a clinical-like, pathological condition with its own antecedents (aetiology) and outcomes (symptoms). As a result, the analysis and integration of the extant literature allowed the postulation of the comprehensive guiding framework for OVF presented in Fig. 1.

Fig. 1, above, depicts the proposed theoretical model for OVF, showing its interconnections and some core features, including their typical occurrence throughout the main phases of the NPD process, namely scoping, specification, development and launch phase. OVF and its antecedents tend to concentrate and occur multiple times between the scoping and development phases. For example, an excessive inflow of requirements could happen during the specification and/or development phase, and this can generate over-specification and/or feature creep (Boehm et al., 2000).

What have been labelled 'outcomes' (symptoms), instead, tend to manifest towards the late development phase or after the launch, as an effect of OVF. Examples are feature fatigue, budget overruns and project delays, which derive from an excessive number of features.

As shown in Fig. 1, OVF can occur at different stages of the NPD process for various reasons. In most cases, it relates to the uncertainty that naturally characterises the NPD process, which forces the inclusion of several 'buffers', allowing the readjustment of a product throughout its development (Allen et al., 2019; Antioco et al., 2008; Bianchi et al., 2020; Kulk & Verhoef, 2008; Long et al., 2021).

The emergence of OVF within an NPD project can be due to a combination of several factors, outlined in Table 2. As mentioned above, it can happen at different stages of the NPD process. For example, when the scope of an NPD project is expanded beyond the resources of the company and not accurately revised based on resource constraints, it is likely to incur overscoping (Bjarnason et al., 2012). Likewise, if project managers do not freeze the escalation of including additional features during the development process, a series of adverse outcomes can be generated (Allen et al., 2019; Long et al., 2021; Repenning, 2001).

Fig. 2 proposes a conceptual comparison between two alternative situations. Situation A (solid line) shows an NPD project starting from the safe area, creeping into the tolerance area and back to the safe one, reaching no critical situation associated with OVF. In

Table 2
Antecedents (Aetiology) of OVF.

		Overspecification	Overdesign	Feature creep	Featuritis	Scope creep	Overscoping
Antecedents (Aetiology)							
Uncertainty driven	Fuzzy front-end	X	X	p		X	p
	Excessive safe margins (buffers) against uncertainty	X	X	p		p	p
	Rapid technological change	X	X	X		p	p
	Changes in legal/regulatory environment during the project		X	X		X	
Market driven	Leave-all-options- open approach	X	p	p	p	X	p
	One-size-fits-all approach	X	X	X		X	p
	Attract new customers	X		X	X		X
	Excessive acquiescence to consumers' requests	X	p	p	X	p	X
	Competitive pressure	X	X	X	X	X	p
Cognitive driven	Cognitive biases	X	X	p	p	X	X
	Cognitive styles	X	X		p	p	
Project driven	Looking for continuous improvement	X	X	X		p	
	Continuous requirements inflow		X	X	p	p	X
	Unclear overview of the available resources		X			p	X
	Unfocused project goals		p			X	p
	Low involvement of development team/ stakeholders during specification phase	X	X			X	X

'X' marks the antecedents that, given our current knowledge from the available literature, are likely to have a stronger pathogenic influence on an NPD process. 'p' marks the antecedents that may contribute to the development of OVF, although their effects are still unclear or yet to be fully assessed by the available literature.

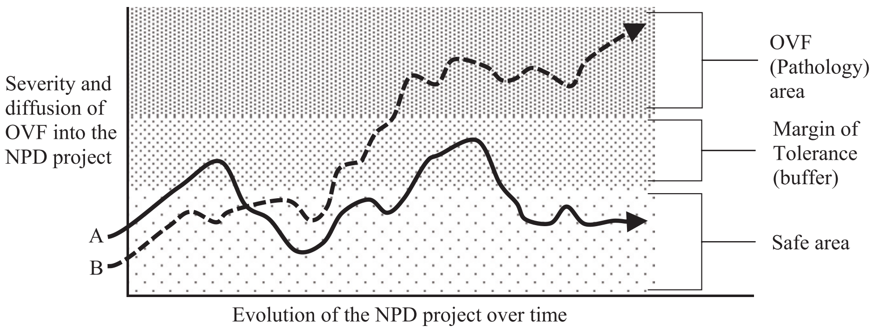

Fig. 2. NPD project timeline and escalation of OVF.

Situation A, project management best practices, review of requirements and scope reduction and an estimation of features' net present value allow for a readjustment of the project (Allen et al., 2019; Coman and Ronen, 2010; Kulk and Verhoef, 2008). In Situation B (dashed line), the project starts from the same safe area but escalates from the margin of tolerance towards a pathological state. When inside the margin of tolerance, an escalation of adverse conditions or failure to recognise the early stages of OVF inevitably brings the project to a point of no return at which the OVF spreads (Brahma and Wynn, 2020; Long et al., 2021; Repenning, 2001).

Furthermore, as is sparsely shown in the literature, the various forms of OVF are not necessarily independent of each other but, rather, highly interconnected (see Fig. 1). In this sense, the boundaries between one form of OVF and another can be blurred, as they are tangled and tend to reinforce each other (Allen et al., 2019; Bianchi et al., 2019; Shmueli and Ronen, 2017). Different forms of OVF can coexist in the same project, and one form of OVF can generate another (Bianchi et al., 2019; Coman and Ronen, 2010). Upstream forms of OVF (overscoping, overspecification and scope creep) may influence or even generate downstream forms of OVF, such as feature creep, featuritis and overdesign (Fig. 1). For example, if the scope of the project is expanded during development, it generates scope creep; consequently, to address the new, enlarged scope of the NPD project, new features are needed, generating feature creep (Buschmann, 2009, 2010; De Giovanni, 2019; Elliott, 2007).

To summarise, OVF can be configured like a clinical disease of the NPD project, with a variety of antecedents (aetiology) and outcomes (symptoms). Mild forms of OVF exist in every NPD project as a result of the natural uncertainty inherent in the development process itself, but an NPD process can only reach a pathological state when it goes beyond the margin of tolerance, which can happen at various stages of the NPD process.

Having explored the general conceptual model of OVF, this paper will now unpack specific facets depicted in Fig. 1, namely antecedents (aetiology) and outcomes (symptoms).

4.1. *Antecedents (Aetiology) of Over Featuring*

As in clinical conditions, several antecedents can concur in the origination of OVF. Table 2 presents the antecedents identified and examined by the extant literature, categorised in accordance with their primary drivers. It is worth noting that Table 2 summarises findings already explored in the available literature; thus, there is empirical support for the antecedents examined.

As mentioned above, several antecedents could be the source of OVF. More specifically, the relationship between OVF and antecedents is many-to-many: a single antecedent could prompt the development of various forms of OVF, and multiple antecedents can be involved in the development of more types of OVF (Elliott, 2007; Shmueli and Ronen, 2017). The antecedents of OVF can be classified into four main driving areas: uncertainty-, market-, cognitive- and project-driven.

The first category, uncertainty-driven, includes conditions arising from the extreme ambiguity of the external environment which push the NPD project outside its boundaries (Allen et al., 2019; Backman et al., 2007; Bianchi et al., 2019; Kulk and Verhoef, 2008). In cases of this sort, expanding the scope and the specifications, as well as adding extra features, represent potential strategies to reduce the fuzziness of customers' needs (Bianchi et al., 2019). However, intentionally excessive safe margins can cause OVF (Allen et al., 2019; Coman and Ronen, 2010; Kulk and Verhoef, 2008). A poor understanding of users' needs can lead engineers, developers, R&D managers and project managers to include buffers aimed at facilitating possible future upgrades of a product (Brahma and Wynn, 2020; Coman and Ronen, 2010; Wouters et al., 2011). When the technological pace is high (e.g., smartphone industry) or the regulatory environment is turbulent (e.g., telecommunication and cybersecurity industries), including a safe margin during an NPD project helps in anticipating possible and unexpected changes to the needs of the market and users (Allen et al., 2019; Brahma and Wynn, 2020; Wouters et al., 2011).

As regards market-driven antecedents, studies show that marketing and technical departments are often competing to find the ideal balance between a product's attractiveness to customers and its technical feasibility (Goodman and Irmak, 2013; Rust et al., 2006; Stock, 2011; Thompson et al., 2005; Thompson and Norton, 2011). Two common antecedents of OVF are what we can call the 'leave-all-options-open' and 'one-size-fits-all' approaches. The first is an intentional delay in the closure of a project, with the aim of addressing any users' needs which may emerge during the development phase (Backman et al., 2007; Bianchi et al., 2019; Coman and Ronen, 2010; De Giovanni, 2020; Wouters et al., 2011). For example, Philips developed products with silent and incomplete features to leave all options open for future market needs (Wouters et al., 2011). The 'one-size-fits-all' approach, in contrast, refers to the belief that users prefer an all-rounder – convergent – product that addresses several user needs in a 'Swiss knife' fashion (Gill, 2008; Goodman and Irmak, 2013; Han et al., 2009). The 'one-size-fits-all' approach could also result from the desire to bring together, in a single product, the needs of both basic and advanced users (Coman and Ronen, 2010; Gill, 2008; Goodman and Irmak, 2013; Jain, 2019).

Market-driven OVF can also depend on the attempt to attract new or returning customers by asking for unrealistic features or performance (Bjarnason et al., 2012; Eytam et al., 2017, 2020; Rust et al., 2006; Thompson et al., 2005). Thomson and Norton (2011) examined the social aspects of selecting a product with a high number of features and capabilities. Their results showed that having a product with a high number of features and capabilities increases the positive social impression for public display. Users accept a decrease in usability due to an excessive number of features in return for the opportunity to make a positive social impression. This is particularly true for conspicuous consumption (e.g., luxury goods), where consumers prefer feature-rich products, sacrificing usability. On the contrary, consumers select products with the fewest features when they are looking for performance and usability, usually in utilitarian products (Thompson and Norton, 2011).

Similarly, including additional features resulting from an excessive acquiescence to users' desires could cause the project to include low-quality features or features with a limited user base (Bleda et al., 2021; Buschmann, 2010; Shmueli et al., 2015). Finally, competitive pressure plays a crucial role in generating OVF, particularly in mass markets such as the consumer electronics, domestic appliances and automotive segments (Rust et al., 2006). Here, always new and alluring features represent a competitive leverage to attract new customers, retain old ones or increase re-purchases (Bleda et al., 2021; Thompson et al., 2005). This results in extreme pressure on development departments to continuously include new and additional features (Bleda et al., 2021; Christensen and Bower, 1996; Coman and Ronen, 2010).

Moving to cognitive drivers, several studies have shown that a variety of cognitive and emotional variables can contribute to OVF, including cognitive biases, emotions and the behaviour of project managers, engineers, developers and R&D managers (Antioco et al., 2008; Belvedere et al., 2013; Bianchi et al., 2019; Shmueli et al., 2015, 2016). In contexts of uncertainty, human biases such as overconfidence, anchoring, planning fallacy, sunk-cost fallacy and perfectionism affect the decision-making process, reflecting their effect on the NPD process (Bianchi et al., 2019). For instance, extant research shows that biases in decision-making favour the uncontrolled expansion of product features, as the developers tend to excessively overestimate the usefulness of their own developed features (Shmueli et al., 2015, 2016). Likewise, the irrational attachment to a project, a specific technology or a particular set of features creates a ripple effect, leading to OVF (Bianchi et al., 2019; Shmueli et al., 2015). Several studies have shown that developers are affected by a series of cognitive biases during the development process, such as the IKEA effect, I-designed-myself effect or emotional attachment (Bianchi et al., 2019; Franke et al., 2009; Norton et al., 2012). The literature also shows that cognitive styles (e.g., rational vs. intuitive), can be associated with OVF (Bianchi et al., 2019). Finally, developers are highly skilled professionals and 'power users' with an attitude that demands state-of-the-art technology in the products they use (Coman and Ronen, 2010). The dissonance between the developers' and final users' perceptions of value creates the antecedents for proposing products beyond the needs of the market (Bianchi et al., 2019).

Regarding the project-driven antecedents, the quest for continuous improvement may be a double-edged sword for NPD. Project managers, developers and the other actors directly involved in the NPD process often push to achieve the highest technological level possible (Bianchi et al., 2020; Davis and Venkatesh, 2004), which might involve the implementation of extremely recent, immature technologies (Coman and Ronen, 2010). This endless desire for improvement can require constant changes in the product's basic architecture, which paves the way for OVF (Backman et al., 2007; Coman and Ronen, 2010). The optimal trade-off between the advantages and disadvantages of a new but yet untested technology should be considered, especially during the later developmental stages (Christensen and Bower, 1996; Davis and Venkatesh, 2004; Schmidt et al., 2001). Similarly, a continuous and uncontrolled stream of requirement inflow during both development and specification phase is a potential cause of OVF (Ajmal et al., 2021; Bjarnason et al., 2012).

As regards the resources and goals of the project, poor assessment of the resources available for a project generates a tendency to overshoot its size and scope (Bjarnason et al., 2012; Chen et al., 2009). Equally, unfocused project goals are antecedents of scope and feature bloat because of the project boundaries' fuzziness (Bjarnason et al., 2012; Jain, 2019). Finally, the low involvement of the development team during the specification phase can create a misalignment between the technical feasibility of specific features and customers' needs (Coman and Ronen, 2010). Technical teams should be involved in the specification phase to avoid the inclusion of unrealistic or unfeasible features (Bjarnason et al., 2012; Coman and Ronen, 2010).

Table 3
Outcomes (Symptoms) of OVF.

		Overspecification	Overdesign	Feature creep	Featuritis	Scope creep	Overscoping
Outcomes (Symptoms)							
After Launch	Feature fatigue	X	X	X	X	X	X
	Quality issues	X	X	X	X	X	X
	Customers' expectations not met	p	p	p	X	p	X
During Dev.	Budget overruns	X	X	X	p	X	X
	Project delays	p	X	X	p	X	X
	Project loses focus	X	X	p	p	X	X

'X' marks outcomes that are identified within the literature and likely to occur in the context of a given OVF. 'p' marks outcomes which may occur, although their effects are still unclear or not fully explored by the literature.

As regards clinical diseases, the antecedents (aetiology) of OVF are complex and multifactorial, involving single antecedents of major effects as well as multiple factors concurring in generating OVF. Indeed, the antecedents of OVF depend on uncertainty from a variety of sources, ranging from external factors (e.g., shifts in customers' preferences, competitors' strategic moves, nascent technological trajectories) to individual-level factors (developers' creative responses to discoveries during the project, cognitive biases, the co-evolution of technical solutions in the interacting product components).

4.2. Outcomes (symptoms) of Over Featuring

As shown in Fig. 1, OVF is characterised by a series of tangible outcomes. Table 3 presents a list of such outcomes grouped in two categories: first, outcomes emerging during the NPD development process; second, those emerging after the launch of the product/service. The symptoms proposed in Table 3 stem from the extant body of literature; thus, there is empirical support for them.

As shown in Table 3, the two most widespread outcomes of OVF are feature fatigue and quality issues. Feature fatigue, explored by Thompson et al. (2005), is the difficulty experienced by users with products that offer an extensive and excessive set of features and capabilities (Rust et al., 2006; Thompson et al., 2005). Having an excessive number of features creates overcomplexity for the users, resulting in fatigue during the regular use of the product or service (Rust et al., 2006; Thompson et al., 2005).

Thompson et al. (2005) showed that three desirable outcomes can depend on the number of features of a product. While companies should use the number of features to pursue specific market objectives, the optimal point is a balanced number of features which can optimise the net value of a product (Thompson et al., 2005).

The following figure (Fig. 3), inspired by Thompson et al. (2005), depicts the outcomes achievable with different sets of features. The first desirable outcome, represented in Fig. 3 as Point A, maximises the net value for customers by offering a product with a proportionate set of features. The second possible outcome, Point B, exploits initial purchase by offering an alluring but highly featured product. The last, Point C, maximises repurchase by offering a simple but reliable product with a limited number of features. As a result, depending on the organisation's goal, the boundaries of the product should be set between Points B and C (Thompson et al., 2005). Fig. 3 highlights the effects of excessive features selection: above Point B, the product has an excessive number of features, resulting in feature fatigue for the users (Thompson et al., 2005).

From an OVF standpoint, an overspecified and/or overdesigned item would result in an excessively featured product or in an all-rounder product moving its features frontier beyond Point B, resulting in a feature-fatigue-affected product (Stock, 2011). This point was confirmed by the later studies of Bjarnason(2012) , Elliot (2007) , Buschmann (2009, 2010), Stock (2011), Delpechitre (2019) and Jain (2019). However, the current body of knowledge about OVF indirectly suggests that feature fatigue is one of the final, most tangible, outcomes of OVF (Bjarnason et al., 2012; Coman and Ronen, 2010; Elliott, 2007). Paradoxically, the effects of OVF are poorly empirically explored in relation to feature fatigue, which is rarely reconnected with the NPD process (Coman & Ronen, 2010; Jain, 2019).

Moving to quality issues and consumers' expectations not being met, the literature shows a significant correlation between these and OVF (Bjarnason et al., 2012; Gregori and Marcone, 2019; Mafael et al., 2022; Shmueli et al., 2016). When extra features are added, they compete and clash to grab resources allocated to the project (Bianchi et al., 2019; Bjarnason et al., 2012). Increasing workloads due to endless requirements and feature inflow cause loss of focus on the resources devoted to each feature: same resources and more features leads to less attention being allocated to each (Bjarnason et al., 2012). The typical outcome is a product that is delivered with some low-quality features, which results in a poor user experience (Bianchi et al., 2019; Bjarnason et al., 2012; Davis and Venkatesh, 2004).

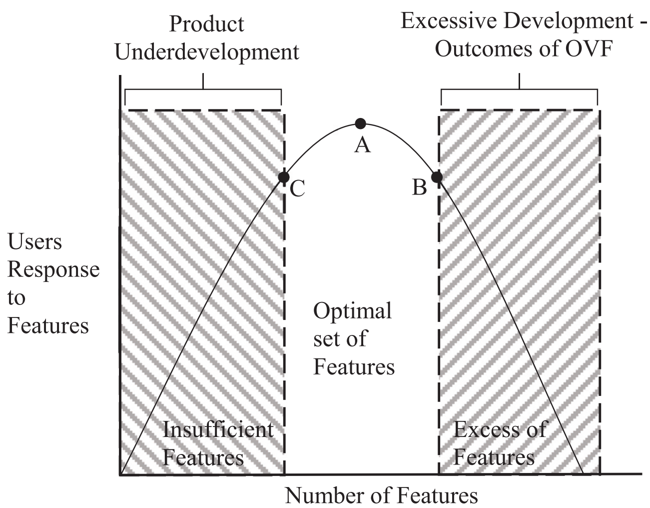

Fig. 3. Strategies for selecting the number of product features.

Scope bloats do not only result in feature fatigue but also affect the quality of the whole NPD project in a rapid escalation of adverse, cumulative effects (Buschmann, 2010; Coman and Ronen, 2010; Davis and Venkatesh, 2004; Gill, 2008). Quality issues are frequently interrelated with feature fatigue (Rahman and Manzur Rahman, 2009; Rust et al., 2006; Thompson et al., 2005).

OVF outcomes are not limited to the launch and after-launch phases but might also happen during the development stages, including budget overruns, project delays and project loss of focus (Coman and Ronen, 2010; Garcia et al., 2019; Gil and Tether, 2011; Shmueli and Ronen, 2017). The underlying human predisposition to consider cumulative effort as linear does not take into consideration that each additional feature added to the project exponentially increases the complexity of the system's architecture (Coman and Ronen, 2010; Garcia et al., 2019; Shabi et al., 2021). As a result, many OVF outcomes are due to an underestimation of how additional features will impact the NPD process by causing an exponential, rather than linear, increase in the project's complexity (Alahyari et al., 2019; Backman et al., 2007; Coman and Ronen, 2010). The enthusiasm aroused by a highly capable and feature-rich product inexorably clashes with the significant refactoring needed to complete, integrate and test an extensive set of features that will likely generate massive costs and schedule slips (Buschmann, 2010; Eliëns et al., 2018; Elliott, 2007; Shmueli et al., 2015).

4.3. *Over Featuring and its relation with Stage-Gate and Agile*

The literature on NPD proposes two divergent approaches to manage the high degree of uncertainty inherent in the NPD process, namely Stage-Gate and Agile (Bianchi et al., 2020). While the analysis of the literature reveals that scholars have explored OVF only in specific circumstances, through bringing together the pieces of this fragmented literature, it is possible to comprehend when OVF is likely to occur throughout the various phases of the main NPD approaches, namely Stage-Gate and Agile. The first attempts to control uncertainty through extensive analysis and planning are made at the outset of the NPD process. The last attempts to respond to uncertainty are made through a gradual progression of product requirements and plans during the development process. In the middle, hybrid Agile-Stage-Gate models have been recently developed which attempt to glean both the benefits of an upfront and granular project specification and market understanding and of an increased margin of flexibility to adapt the project in due course (Cooper and Sommer, 2016; de Vasconcelos Gomes et al., 2021; Kulk and Verhoef, 2008; Salvato and Laplume, 2020).

The divergent nature of Stage-Gate and Agile emerges in their approach to managing uncertainty, specifications and how to address users' needs. The rationale of the Stage-Gate approach is to invest extensive resources in early knowledge collection, such as market intelligence and technology scouting, in order to generate an accurate product design and business case, thus minimising the likelihood of costly revisions in the implementation phase (Antioco et al., 2008; Bianchi et al., 2020). The Agile approach, in contrast, is grounded on the idea that substantial upfront investment in prediction yields little return, as technological and market conditions can change dramatically and unpredictably over the course of the project (Bianchi et al., 2020; de Vasconcelos Gomes et al., 2021).

These substantial differences in the nature of the two approaches also emerge in how OVF manifests. As shown in Figs. 4 and 5, OVF appears to spread across the various stages of the NPD process, from the initial discovery and scoping to post-launch review (Bianchi et al., 2019, 2020; Bjarnason et al., 2012).

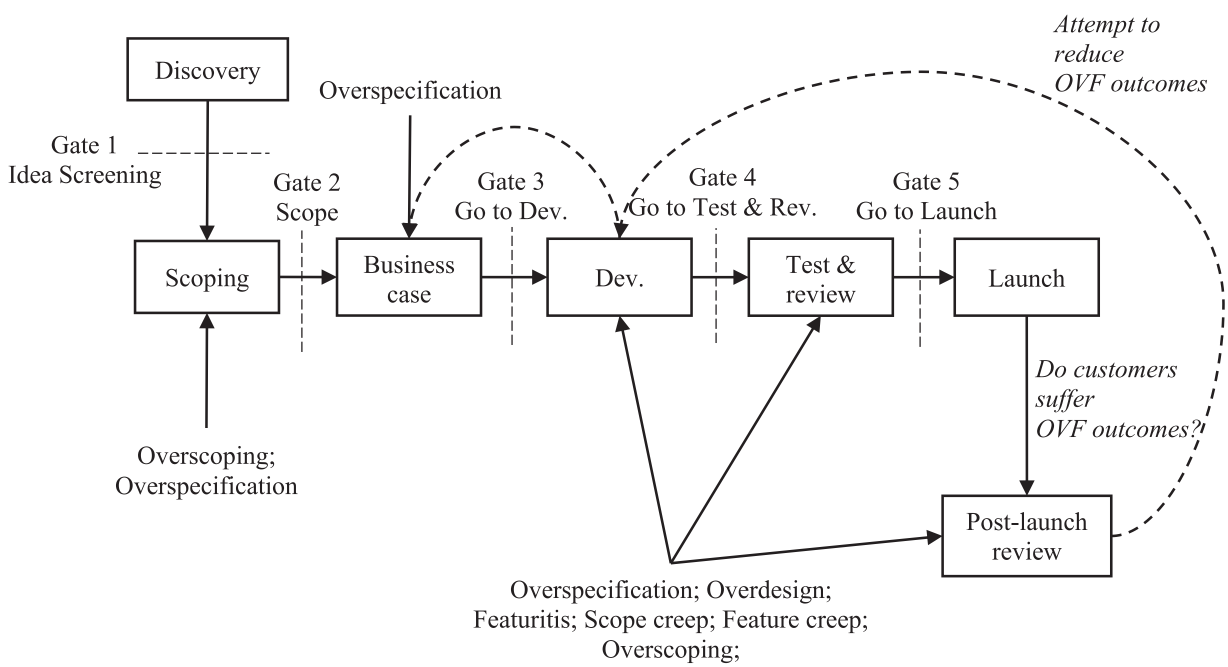

Fig. 4. OVF and the Stage-Gate approach.

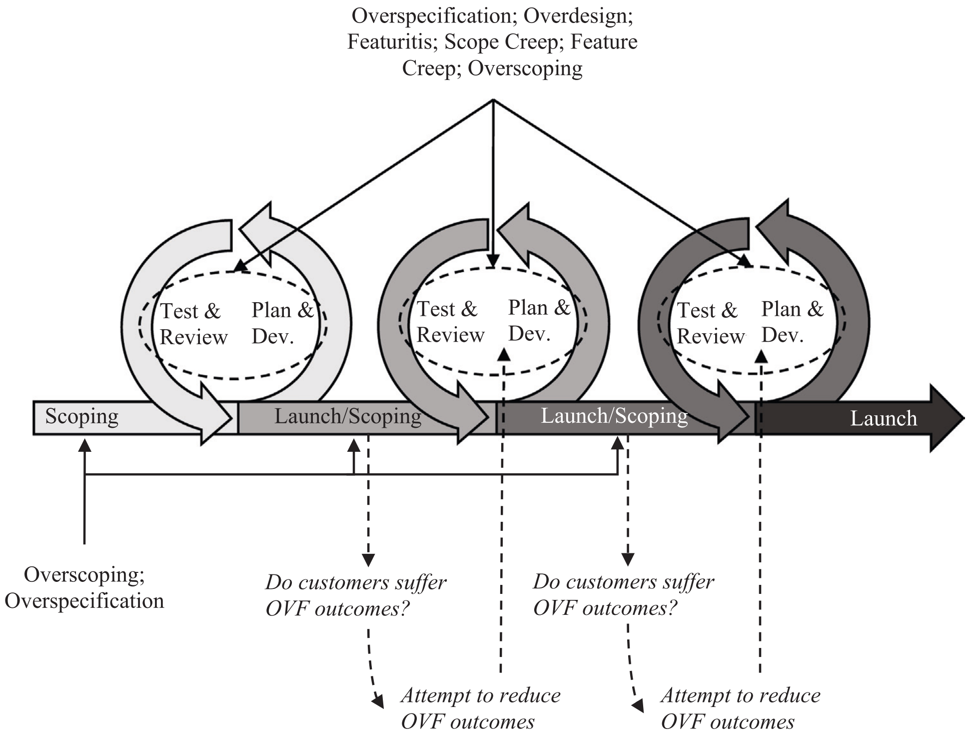

Fig. 5. OVF and the Agile approach.

Regarding the Stage-Gate process (Fig. 4), OVF is primarily concentrated in the development, test and review and post-launch phases (Bianchi et al., 2019; Bjarnason et al., 2012; Cooper and Sommer, 2016). Overscoping and overspecification are risky forms of OVF in the early steps of the NPD process (Bjarnason et al., 2012; Choi and Bae, 2009).

An additional risk during development, test and review and post-launch is represented by the possible modifications of the specifications or scope of the project. Two situations are likely to take place. The first occurs when a new technology, a sudden new requirement inflow or changes in the external environment require the specifications or scope of the project to be rectified (Chen et al., 2009; Choi and Bae, 2009; de Vasconcelos Gomes et al., 2021; Thal et al., 2010). The second occurs when OVF outcomes are identified after the launch. In this case, during the post-launch review, an attempt to mitigate such outcomes can be made by revising the whole NPD project (Chen et al., 2009; Shmueli et al., 2015), even at the business case stage (Coman and Ronen, 2010; Eliëns et al., 2018; Schmidt and Calantone, 2002). However, although this endeavour could bring some benefits, it exposes the NPD project to an additional risk of OVF (Chen et al., 2009; Shmueli et al., 2015). Thus, it appears crucial to identify potential OVF signs in the first development cycle, reducing the need for post-launch reviews (Coman and Ronen, 2010). As the Stage-Gate approach is remarkably intolerant to changes after specification freeze, developers tend to include buffers against uncertainty or silent functionalities, usually by overspecification (Bianchi et al., 2019; Wouters et al., 2011).

Fig. 5 depicts the occurrence of OVF over the various cycles of the NPD process. Through the Agile development approach, the development phases are unpacked and repeated several times, with continuous tests and reviews with final users (Bianchi et al., 2020; B. Boehm and Turner, 2005). The Agile approach gives additional flexibility to the project, a gradual definition of the scope and requirements and a continuous revision of the features included in the various releases of a product. However, the extreme flexibility of an Agile process could represent an endogenous risk for OVF (Bianchi et al., 2020; de Vasconcelos Gomes et al., 2021; Khanagha et al., 2021; Yin et al., 2021). Such flexibility, grounded on fast development cycles – together with continuous revisions of the scope and requirement – can favour, rather than prevent, the emergence of OVF, resulting in a higher risk of OVF than with the Stage-Gate approach (Bjarnason et al., 2012; Khanagha et al., 2021).

By contrast, if the Agile process is well managed and the scope, requirements and features inflow are controlled, the continuous feedback from users could, in fact, reduce the complexity of the project (Bianchi et al., 2020; Bjarnason et al., 2012; B. Boehm and Turner, 2005; Yin et al., 2021). Although the literature about Agile practices and OVF is limited, the study by Bjarnason and colleagues (2012) suggests that Agile-based processes are highly efficient in avoiding OVF if close attention is paid to scope prioritisation, gradual requirement inflow and close cooperation within cross-functional teams (Bjarnason et al., 2012).

On a final note, it appears that a Stage-Gate–hybrid approach could be a possible remedy for OVF (Cooper and Sommer, 2016; Salvato and Laplume, 2020). The combination of project stability and continuous availability of feedback from final users could allow the NPD project to be constantly revised while not falling into the trap of OVF (Bianchi et al., 2020; de Vasconcelos Gomes et al., 2021; Long et al., 2021; Salvato and Laplume, 2020).

5. Conclusions

The present study defines the phenomenon of OVF and proposes a conceptual and integrative framework to clarify this widespread but under-explored phenomenon. Grounded in the theoretical and empirical findings on the topic, the present research takes stock of the OVF situation and serves as a springboard for further advances on the topic.

5.1. Implications

In the present study, the nature of OVF has been explored within the NPD literature. Several implications, both managerial and theoretical, emerge from the conceptualisation of OVF.

First, managers and practitioners are invited to reflect on when and how they have encountered excessive development issues during their everyday practice. The present study wishes to emphasise the need for careful definition of the boundaries of an NPD project and how an excessive load of features could harm the success of such a project. Several project manager and developer biases, overestimation of the complexity of a project and the fuzzy perception of what is needed by users are among the roots of OVF, often leading to a negative performance of the NPD process (Coman and Ronen, 2010).

Second, managers and project managers should carefully evaluate the value drivers of a product or a service, understanding the risks of an excessively developed item. In fact, the goal of a successful NPD project should be to maximise the positioning on the market without harming the item's usability or generating resource exhaustion within companies (Bianchi et al., 2019). As a result, an emphasis should also be placed on how the NPD process is managed.

Third, Stage-Gate, Agile and hybrid approaches are commonly adopted to efficiently manage the development process. However, the limited understanding of OVF does not always allow such approaches to extensively manage the uncontrolled expansion of features, especially in the later phases of the NPD process (Bianchi et al., 2020). Lastly, as suggested by Khanagha et al. (2021), the extensive and often inflated use of Agile approaches in managing the NPD process could lead to increasing pressure on development teams, escalation of commitment and unclear NPD process execution modes, which could favour the emergence of OVF issues.

From the theoretical side, the present study clarifies the ontological and taxonomical nature of OVF. As shown, the phenomenon of OVF could emerge early in the NPD process, becoming tangible only in the final development stages. Due to terminological confusion, formalisation of OVF has been limited among scholars and practitioners. The present study proposes a clearer classification of the terms, clarifying the multifaceted nature of the phenomenon. Moreover, the integration of studies from a diverse set of sources has allowed a better understanding of the entire ontogenesis of OVF, starting from its antecedents, evolving into a pathological state in the NPD process and later manifesting through a variety of outcomes – symptoms – such as feature fatigue.

5.2. Future research

The multifaceted nature of OVF still raises several questions for scholars and practitioners that require further empirical and conceptual investigation. The three key aspects of OVF still deserve to be better explored, namely the antecedents, outcomes and nature of OVF itself.

Antecedents appear to be the most studied aspects of OVF to date. Although the complete aetiology of OVF is yet to be clarified, previous studies have identified the involvement of cognitive biases (Belvedere et al., 2013; Bianchi et al., 2019; Shmueli et al., 2015, 2016) and dysfunctional project management practices (Bjarnason et al., 2012). However, there is still a need to identify additional and precise aspects that can trigger OVF. For example, it may turn out to be essential to rebuild the entire decisional chain that leads to the emergence of OVF, both in the scoping and development phases. Next, while some internal antecedents have been explored (Bjarnason et al., 2012; Coman and Ronen, 2010), it is necessary to advance our understanding of how, and to what extent, external and unpredictable variables, such as market turmoil and technological pace, can affect the health of an NPD project.

Moving to the outcomes of OVF, the current state of knowledge is highly fragmented. While some studies have explored the effects of OVF on product and project performance (Bianchi et al., 2019; Bjarnason et al., 2012; Chen et al., 2009; Choi and Bae, 2009; De Giovanni, 2019; Garcia et al., 2019; Gregori and Marcone, 2019), there is a need to understand the impact of OVF on specific aspects of product and project performance. Examples are costs, speed, quality, customer satisfaction and product placement. Previous studies have laid the foundations for studying the negative effects of OVF on NPD, but is unclear at what stages of the process, how and to what extent OVF affects NPD performance (Bjarnason et al., 2012). Other crucial aspects of OVF outcomes relate to the role of feature fatigue, which appears to be highly connected with OVF (De Giovanni, 2019; Rust et al., 2006; Thompson et al., 2005; Wu et al., 2015). While Thompson et al. (2005) showed that the role of features in product success and placement is crucial for the company's product portfolio, the present study highlights a critical gap in the literature and a severe underestimation of the role of OVF in the feature fatigue literature. A possible solution lies in including additional scalability and modularity to products and services, allowing an ad hoc customisation and segmentation through the use of product platforms (Wouters et al., 2011).

A key open question relates to the absence of a multidimensional tool capable of measuring and assessing OVF. In this sense, seminal studies have proposed tools to measure certain, but limited, facets of OVF. Bianchi et al. (2019) proposed a scale to measure the sub-constructs underlying BNE, while Belvedere et al. (2013) specifically focused on overdesign. Other studies have approached OVF through experiments (Shmueli et al., 2015, 2016) or qualitative/case analyses (Bjarnason et al., 2012; Garcia et al., 2019; Jain, 2019; Shabi et al., 2021; Wouters et al., 2011). However, a comprehensive measurement tool for OVF is lacking. It is of the utmost importance to have tools that can identify the specific types of OVF at stake in any given phase of NPD, from scoping to post-launch review (Boehm and Turner, 2005). It should be acknowledged that in specific industries, where the technological pace is dramatically fast and the competition is extreme, OVF could be one strategy to create a safe margin against uncertainty (Christensen and Bower, 1996). Therefore, the role of OVF may vary across industries, and the different pace of technological innovation and competition could shape the magnitude of and need to use OVF to mitigate uncertainty (Bianchi et al., 2019; Christensen and Bower, 1996).

5.3. Limitations

Regarding the limitations of the present study, in summarising the findings, the reflections and the suggestions of the research, the richness and the depth of each single study's focus is inevitably lost. Furthermore, as the present study is grounded in the literature already available on the topic, it allows only a partial theoretical advancement. Therefore, the need clearly emerges to carry out additional empirical studies to better understand the phenomenon of OVF.

Data Availability

Data and Methodological procedures are available on Appendix A of the manuscript.

Acknowledgements

I would like to cordially thank the handling editor Prof. Jeremy Hall, the three anonymous reviewers, Mr. Stefano Panerai, and Dr. Emilio Rossi for the insightful comments during the development of the present study.

Appendix A

The following research terms were used to extract the relevant literature from the databases. The literature scanning started with well-known research terms (e.g., 'Scope Creep') and iteratively expanded during the development of the paper, whereas additional terms emerged from the analysis of the literature (e.g., 'Performitis') using a snowballing approach, as suggested by Cronin and George (2020). All the terms were searched with all possible variations: with and without hyphen, with and without spaces, singular and plural.

The research terms for database scanning are the following: 'Bells-and-whistles'; 'Beyond Needs Excess'; 'Beyond Plans Excess'; 'Beyond Resources Excess'; 'BNE'; 'BPE'; 'BRE'; 'Design Creep'; 'Excessive Development'; 'Feature Bloat'; 'Feature Creep'; 'Feature Fatigue'; 'Feature Overload'; 'Featuritis'; 'Flexibilitis'; 'Gold-plating'; 'Mission Creep'; 'Nice-to-have feature'; 'One-size-fits-all'; 'Over Doing'; 'Over Killing'; 'Overdesign'; 'Over-requirement'; 'Overscoping'; 'Overshooting'; 'Overspecification'; 'Performitis'; 'Over-engineering'; 'Over-engineering'; 'Requirement Creep'; 'Scope Creep'; 'Scope Overload'; 'Technology Overload'; 'Unnecessary Feature'; 'Unnecessary Requirement'.

The results of the various queries were manually analysed and scanned by reading all the abstracts and the papers retrieved. The studies were therefore manually selected from those referring to and discussing the various forms of excessive development in the NPD process, following the most influential works on OVF (Bianchi et al., 2019; Bjarnason et al., 2012; Buschmann, 2009, 2010; Coman and Ronen, 2010; Elliott, 2007; Gregori and Marcone, 2019; Shmueli and Ronen, 2017; Thompson et al., 2005). The material included in the present study was limited to that discussing OVF-related topics in the NPD process or the antecedents or outcomes of OVF. The domains included are related to physical products, services and software. Material discussing requirement engineering in general was included when it referred to the effect of an excessive number of features or requirements.

The following table (Table 4) presents the list of materials included in the integrative review. The list includes mainly peer-reviewed academic journals. However, when a different source is included, the type of source is specified in italics in the 'Source' column. For the sake of completeness, grey literature is included if it has contributed to the advancement of OVF, as suggested by Adams et al. (2017) and Cronin and George (2020).

Finally, in Table 4, the material retrieved not by direct query on the databases but through a bi-directional manual analysis of the references cited in the extracted documents is marked 'SS' ('Secondary Sourced'). This step is suggested by Cronin and George (2020) when the literature on a topic is particularly fragmented and difficult to retrieve using only a database search.

Table 4
List of material included in the integrative review (ordered by publication year).

Author (s)	Title	Year	Source	SS
Abrahams, P.	President's letter - Specifications and Illusions	1988	*Letter* in Communications of the ACM	X
Boehm, B. W., Papaccio	Understanding and Controlling Software Costs	1988	IEEE Transactions on Software Engineering	X
Landis, L., Waligora, S., Mcgarry, F., Pajerski, R., Stark, M., Johnson, K. O., Cover, D	Recommended Approach to Software Development Revision 3	1992	*Report* in NASA Goddard Space Flight Center - Software Engineering Laboratory Series.	X
Christensen, C. M., Bower, J. L.	Customer power, strategic investment, and the failure of leading firms	1996	Strategic Management Journal	X
Boehm, B., Port, D., Al-Said, M.	Avoiding the software model-clash spiderweb	2000	Computer	X
Ropponen, J., Lyytinen, K	Components of software development risk: how to address them? A project manager survey	2000	IEEE Transactions on Software Engineering	X
Schmidt, R., Lyytinen, K., Keil, M., Cule, P.	Identifying software project risks: An international Delphi study	2001	Journal of Management Information Systems	
Dean Hendrix, T., Schneider, M. P.	NASA's TReK Project: A Case Study in Using the Spiral Model of Software Development	2002	Communications of the ACM	X
Knight, K., Robinson Fayek, A.	Use of Fuzzy Logic for Predicting Design Cost Overruns on Building Projects	2002	Journal of Construction Engineering and Management,	
Davis, F. D., Venkatesh, V.	Toward preprototype user acceptance testing of new information systems: Implications for software project management	2004	IEEE Transactions on Engineering Management	
Boehm, B., Turner, R.	Management challenges to implementing agile processes in traditional development organizations. IEEE	2005	IEEE Software	X
Thompson, D. V., Hamilton, R. W., Rust, R. T.	Feature fatigue: When product capabilities become too much of a good thing	2005	Journal of Marketing Research	
Damian, D., Chisan, J.	An empirical study of the complex relationships between requirements engineering processes and other processes that lead to payoffs in productivity, quality, and risk management	2006	IEEE Transactions on Software Engineering	
Gil, N., Tommelein, I. D., Schruben, L. W.	External change in large engineering design projects: The role of the client	2006	IEEE Transactions on Engineering Management,	
Rust, R. T., Thompson, D. V., Hamilton, R. W.	Defeating feature fatigue	2006	Harvard Business Review	
Elliott, B.	Anything is possible: Managing feature creep in an innovation rich environment	2007	IEEE International Engineering Management Conference	
Gill, T.	Convergent products: What functionalities add more value to the base?	2008	Journal of Marketing	X
Mitchener, J.	Less simplicity	2008	*Report* in Engineering and Technology	
Ronen, B., Pass, S.	Focused operations management: achieving more with existing resources	2008	*Book*	X
Buschmann, F.	Learning from failure, Part 1: Scoping and requirements woes	2009	IEEE Software	
Chen, C. C., Law, C. C. H., Yang, S. C.	Managing ERP implementation failure: A project management perspective	2009	IEEE Transactions on Engineering Management	
Choi, K. S., Bae, D. H.	Dynamic project performance estimation by combining static estimation models with system dynamics	2009	IEEE Transactions on Engineering Management	X
Han, J. K., Chung, S. W., Sohn, Y. S.	Technology convergence: When do consumers prefer converged products to dedicated products	2009	Journal of Marketing	X
Rahman, M., Manzur Rahman, M.	To defeat feature fatigue the right way, understand it first	2009	Strategic Direction	
Buschmann, F.	Learning from failure, Part 2: Featuritis, performitis, and other diseases	2010	IEEE Software	
Coman, A., Ronen, B.	Icarus' predicament: Managing the pathologies of overspecification and overdesign	2010	International Journal of Project Management	
Thal, A. E., Cook, J. J., White, E. D	Estimation of Cost Contingency for Air Force Construction Projects	2010	Journal of Construction Engineering and Management	
Gil, N., Tether, B. S.	Project risk management and design flexibility: Analysing a case and conditions of complementarity.	2011	Research Policy	
Stock, R. M.	How does product program innovativeness affect customer satisfaction? A comparison of goods and services	2011	Journal of the Academy of Marketing Science	X
Thompson, D. V., Norton, M. I.	The social utility of feature creep	2011	Journal of Marketing Research	
Bjarnason, E., Wnuk, K., Regnell, B.	Are you biting off more than you can chew? A case study on causes and effects of overscoping in large-scale software engineering.	2012	Information and Software Technology	

(*continued on next page*)

Table 4 (*continued*)

Author (s)	Title	Year	Source	SS
Norton, M. I., Mochon, D., Ariely, D.	The IKEA effect: When labour leads to love	2012	Journal of Consumer Psychology	
Belvedere, V., Grando, A., Ronen, B.	Cognitive biases, heuristics, and overdesign: An investigation on the unconscious mistakes of industrial designers and on their effects on product offering	2013	*Book Chapter* in Behavioural Issues in Operations Management: New Trends in Design, Management, and Methodologies.	
Goodman, J. K., Irmak, C.	Having versus consuming: Failure to estimate usage frequency makes consumers prefer multifeature products.	2013	Journal of Marketing Research	
Shmueli, O., Pliskin, N., Fink, L.	Explaining over-requirement in software development projects: An experimental investigation of behavioural effects	2015	International Journal of Project Management	
Wu, M., Wang, L., Long, H., Li, M.	Feature fatigue analysis in product development	2015	Total Quality Management and Business Excellence	
Davies, A., Dodgson, M., Gann, D.	Dynamic Capabilities in Complex Projects: The Case of London Heathrow Terminal 5	2016	Project Management Journal	X
Shmueli, O., Pliskin, N., Fink, L.	Can the outside-view approach improve planning decisions in software development projects?	2016	Information Systems Journal	
Eytam, E., Tractinsky, N., Lowengart, O.	The paradox of simplicity: Effects of role on the preference and choice of product visual simplicity level	2017	International Journal of Human Computer Studies	X
Hamilton, R. W., Rust, R. T., Dev, C. S.	Which features increase customer retention?	2017	MIT Sloan Management Review	
Liu, N., Yu, R	Identifying design feature factors critical to acceptance and usage behaviour of smartphones	2017	Computers in Human Behaviour	
Shmueli, O., Ronen, B	Excessive software development: Practices and penalties	2017	International Journal of Project Management	
Alahyari, H., Gorschek, T., Berntsson Svensson, R	An exploratory study of waste in software development organizations using agile or lean approaches: A multiple case study at 14 organizations.	2019	Information and Software Technology	X
Allen, J. D., Stevenson, P. D., Mattson, C. A., Hatch, N. W.	Over-Design Versus Redesign as a Response to Future Requirements	2019	Journal of Mechanical Design	
Bianchi, M., Marzi, G., Zollo, L., Patrucco, A.	Developing software beyond customer needs and plans: an exploratory study of its forms and individual-level drivers	2019	International Journal of Production Research	
De Giovanni, P.	A feature fatigue supply chain game with cooperative programs and ad-hoc facilitators	2019	Journal of Production Research	
Delpechitre, D., Black, H. G., Farrish, J.	The dark side of technology: examining the impact of technology overload on salespeople	2019	Journal of Business and Industrial Marketing,	
Garcia, J. J., Pettersen, S. S., Rehn, C. F., Erikstad, S. O., Brett, P. O., Asbjørnslett, B. E	Overspecified vessel design solutions in multi-stakeholder design problems	2019	Research in Engineering Design	
Gregori, G. L., Marcone, M. R.	R&D and manufacturing activities regarding managerial effectiveness and open strategy: an industry focus on luxury knitwear firms	2019	International Journal of Production Research	
Jain, S.	Time inconsistency and product design: A strategic analysis of feature creep	2019	Marketing Science	
Brahma, A., Wynn, D. C.	Margin value method for engineering design improvement	2020	Research in Engineering Design	X
De Giovanni, P.	When feature-based production capabilities challenge operations: Drivers, moderators, and performance	2020	International Journal of Operations and Production Management	X
Eytam, E., Lowengart, O., Tractinsky, N.	Effects of visual simplicity in product design and individual differences in preference of interactive products	2020	Review of Managerial Science	X
Ajmal, M. M., Khan, M., Gunasekaran, A., Helo, P. T.	Managing project scope creep in construction industry	2021	Engineering, Construction and Architectural Management	
Cesaretto, R., Buratto, A., De Giovanni, P	Mitigating the feature fatigue effect for smart products through digital servitization	2021	Computers and Industrial Engineering,	
Long, D., Morkos, B., Ferguson, S.	Toward Quantifiable Evidence of Excess' Value Using Personal Gaming Desktops	2021	Journal of Mechanical Design	
Shabi, J., Reich, Y., Robinzon, R., Mirer, T	A decision support model to manage overspecification in system development projects	2021	Journal of Engineering Design	
Verkijika, S. F.	Download or swipe left: The role of complexity, future-oriented emotions and feature overload	2021	Telematics and Informatics	
Yin, M., Meng, D., Zhu, D., Wang, Y., Jiang, J	Predicting Changes in User-Driven Requirements Using Conditional Random Fields in Agile Software Development	2021	IEEE Transactions on Engineering Management.	X

References

Abrahams, P., 1988. President's letter - specifications and illusions. Commun. ACM 31 (5), 480–481.

Adams, R.J., Smart, P., Huff, A.S., 2017. Shades of grey: guidelines for working with the grey literature in systematic reviews for management and organizational studies. Int. J. Manag. Rev. 19 (4), 432–454. https://doi.org/10.1111/ijmr.12102.

Ajmal, M.M., Khan, M., Gunasekaran, A., Helo, P.T., 2021. Managing project scope creep in construction industry. Eng. Constr. Archit. Manag. https://doi.org/10.1108/ECAM-07-2020-0568.

Alahyari, H., Gorschek, T., Berntsson Svensson, R., 2019. An exploratory study of waste in software development organizations using agile or lean approaches: a multiple case study at 14 organizations. Inf. Softw. Technol. 105, 78–94. https://doi.org/10.1016/j.infsof.2018.08.006.

Allen, J.D., Stevenson, P.D., Mattson, C.A., Hatch, N.W., 2019. Over-design versus redesign as a response to future requirements. J. Mech. Design Trans. ASME 141 (3). https://doi.org/10.1115/1.4042335.

Antioco, M., Moenaert, R.K., Lindgreen, A., 2008. Reducing ongoing product design decision-making bias. J. Prod. Innov. Manag. 25 (6), 528–545. https://doi.org/10.1111/j.1540-5885.2008.00320.x.

Backman, M., Börjesson, S., Setterberg, S., 2007. Working with concepts in the fuzzy front end: exploring the context for innovation for different types of concepts at Volvo Cars. R D Manag. 37 (1), 17–28. https://doi.org/10.1111/j.1467-9310.2007.00455.x.

Belvedere, V., Grando, A., Ronen, B., 2013. Cognitive biases, heuristics, and overdesign: an investigation on the unconscious mistakes of industrial designers and on their effects on product offering. In: Behavioral Issues in Operations Management: New Trends in Design, Management, and Methodologies, 9781447148. Springer, pp. 125–139. https://doi.org/10.1007/978-1-4471-4878-4_6.

Bianchi, M., Marzi, G., Guerini, M., 2020. Agile, Stage-Gate and their combination: exploring how they relate to performance in software development. J. Bus. Res. 110, 538–553. https://doi.org/10.1016/j.jbusres.2018.05.003.

Bianchi, M., Marzi, G., Zollo, L., Patrucco, A., 2019. Developing software beyond customer needs and plans: an exploratory study of its forms and individual-level drivers. Int. J. Prod. Res. 57 (22), 7189–7208. https://doi.org/10.1080/00207543.2019.1581953.

Bjarnason, E., Wnuk, K., Regnell, B., 2012. Are you biting off more than you can chew? A case study on causes and effects of overscoping in large-scale software engineering. Inf. Softw. Technol. 54 (10), 1107–1124. https://doi.org/10.1016/j.infsof.2012.04.006.

Bleda, M., Querbes, A., Healey, M., 2021. The influence of motivational factors on ongoing product design decisions. J. Bus. Res. 129, 562–569. https://doi.org/10.1016/j.jbusres.2020.02.018.

Boehm, B., Port, D., Al-Said, M., 2000. Avoiding the software model-clash spiderweb. Computer 33 (11), 120–122. https://doi.org/10.1109/2.881698.

Boehm, B., Turner, R., 2005. Management challenges to implementing agile processes in traditional development organizations. IEEE Softw. 22 (5), 30–39. https://doi.org/10.1109/MS.2005.129.

Boehm, B.W., Papaccio, P.N., 1988. Understanding and controlling software costs. IEEE Trans. Softw. Eng. 14 (10), 1462–1477. https://doi.org/10.1109/32.6191.

Brahma, A., Wynn, D.C., 2020. Margin value method for engineering design improvement. Res. Eng. Design 31 (3), 353–381. https://doi.org/10.1007/s00163-020-00335-8.

Burke, P.F., 2013. Seeking simplicity in complexity: the relative value of ease of use (EOU)-based product differentiation. J. Prod. Innov. Manag. 30 (6), 1227–1241. https://doi.org/10.1111/jpim.12056.

Buschmann, F., 2009. Learning from failure, Part 1: scoping and requirements woes. IEEE Softw. 26 (6), 68–69. https://doi.org/10.1109/MS.2009.179.

Buschmann, F., 2010. Learning from failure, Part 2: featuritis, performitis, and other diseases. IEEE Softw. 27 (1), 10–11. https://doi.org/10.1109/MS.2010.14.

Cesaretto, R., Buratto, A., De Giovanni, P., 2021. Mitigating the feature fatigue effect for smart products through digital servitization. Comput. Ind. Eng. 156, 107218 https://doi.org/10.1016/j.cie.2021.107218.

Chen, C.C., Law, C.C.H., Yang, S.C., 2009. Managing ERP implementation failure: a project management perspective. IEEE Trans. Eng. Manag. 56 (1), 157–170. https://doi.org/10.1109/TEM.2008.2009802.

Choi, K.S., Bae, D.H., 2009. Dynamic project performance estimation by combining static estimation models with system dynamics. Inf. Softw. Technol. 51 (1), 162–172. https://doi.org/10.1016/j.infsof.2008.03.001.

Christensen, C.M., Bower, J.L., 1996. Customer power, strategic investment, and the failure of leading firms. Strateg. Manag. J. 17 (3), 197–218.

Coman, A., Ronen, B., 2010. Icarus' predicament: managing the pathologies of overspecification and overdesign. Int. J. Project Manag. 28 (3), 237–244. https://doi.org/10.1016/j.ijproman.2009.05.001.

Cooper, R.G., Sommer, A.F., 2016. The Agile–Stage-Gate hybrid model: a promising new approach and a new research opportunity. J. Prod. Innov. Manag. 33 (5), 513–526. https://doi.org/10.1111/jpim.12314.

Corley, K., Gioia, D., 2011. Building theory about theory building: what constitutes a theoretical contribution? Acad. Manag. Rev. 36 (1), 12–32. https://doi.org/10.5465/amr.2009.0486.

Cronin, M.A., George, E., 2020. The why and how of the integrative review. Org. Res. Methods. https://doi.org/10.1177/1094428120935507.

Damian, D., Chisan, J., 2006. An empirical study of the complex relationships between requirements engineering processes and other processes that lead to payoffs in productivity, quality, and risk management. IEEE Trans. Softw. Eng. 32 (7), 433–453. https://doi.org/10.1109/TSE.2006.61.

Davies, A., Dodgson, M., Gann, D., 2016. Dynamic capabilities in complex projects: the case of London Heathrow Terminal 5. Project Manag. J. 47 (2), 26–46. https://doi.org/10.1002/pmj.21574.

Davis, F.D., Venkatesh, V., 2004. Toward preprototype user acceptance testing of new information systems: implications for software project management. IEEE Trans. Eng. Manag. 51 (1), 31–46. https://doi.org/10.1109/TEM.2003.822468.

De Giovanni, P., 2019. A feature fatigue supply chain game with cooperative programs and ad-hoc facilitators. Int. J. Prod. Res. 57 (13), 4166–4186. https://doi.org/10.1080/00207543.2018.1519264.

De Giovanni, P., 2020. When feature-based production capabilities challenge operations: drivers, moderators, and performance. Int. J. Oper. Prod. Manag. 40 (2), 221–242. https://doi.org/10.1108/IJOPM-04-2019-0309.

de Vasconcelos Gomes, L.A., Seixas Reis de Paula, R.A., Figueiredo Facin, A.L., Chagas Brasil, V., Sergio Salerno, M., 2021. Design principles of hybrid approaches in new product development: a systematic literature review. R and D Manag. https://doi.org/10.1111/radm.12476.

Dean Hendrix, T., Schneider, M.P., 2002. NASA's TReK Project: a case study in using the spiral model of software development. Commun. ACM 45 (4), 152–159. https://doi.org/10.1145/505248.506004.

Delpechitre, D., Black, H.G., Farrish, J., 2019. The dark side of technology: examining the impact of technology overload on salespeople. J. Bus. Ind. Mark. 34 (2), 317–337. https://doi.org/10.1108/JBIM-03-2017-0057.

Edwards, C., 2010. The killer iPhone. How Apple designed its new model to be sweet to customers an vicious to rivals. Strateg. Direct. 26 (11), 25–26. https://doi.org/10.1108/sd.2010.05626kad.005.

Eliëns, R., Eling, K., Gelper, S., Langerak, F., 2018. Rational versus intuitive gatekeeping: escalation of commitment in the front end of NPD. J. Prod. Innov. Manag. 35 (6), 890–907. https://doi.org/10.1111/jpim.12452.

Elliott, B., 2007. Anything is possible: Managing feature creep in an innovation rich environment. 2007 IEEE International Engineering Management Conference, 304–307. 〈https://doi.org/10.1109/IEMC.2007.5235049〉.

Eytam, E., Lowengart, O., Tractinsky, N., 2020. Effects of visual simplicity in product design and individual differences in preference of interactive products. Rev. Manag. Sci. 1–43. https://doi.org/10.1007/s11846-020-00391-3.

Eytam, E., Tractinsky, N., Lowengart, O., 2017. The paradox of simplicity: effects of role on the preference and choice of product visual simplicity level. Int. J. Hum. Comput. Stud. 105, 43–55. https://doi.org/10.1016/j.ijhcs.2017.04.001.

Franke, N., Schreier, M., Kaiser, U., 2009. The "I Designed It Myself" effect in mass customization. Manag. Sci. 56 (1), 125–140. https://doi.org/10.1287/mnsc.1090.1077.

Garcia, J.J., Pettersen, S.S., Rehn, C.F., Erikstad, S.O., Brett, P.O., Asbjørnslett, B.E., 2019. Overspecified vessel design solutions in multi-stakeholder design problems. Res. Eng. Design 30 (4), 473–487. https://doi.org/10.1007/s00163-019-00319-3.
Gil, N., Tether, B.S., 2011. Project risk management and design flexibility: analysing a case and conditions of complementarity. Res. Policy 40 (3), 415–428. https://doi.org/10.1016/j.respol.2010.10.011.
Gil, N., Tommelein, I.D., Schruben, L.W., 2006. External change in large engineering design projects: the role of the client. IEEE Trans. Eng. Manag. 53 (3), 426–439. https://doi.org/10.1109/TEM.2006.877447.
Gill, T., 2008. Convergent products: what functionalities add more value to the base? J. Mark. 72 (2), 46–62. https://doi.org/10.1509/jmkg.72.2.46.
Goodman, J.K., Irmak, C., 2013. Having versus consuming: Failure to estimate usage frequency makes consumers prefer multifeature products. J. Mark.. Res. 50 (1), 44–54. https://doi.org/10.1509/jmr.10.0396.
Gregori, G.L., Marcone, M.R., 2019. R&D and manufacturing activities regarding managerial effectiveness and open strategy: an industry focus on luxury knitwear firms. Int. J. Prod. Res. 57 (18), 5787–5800. https://doi.org/10.1080/00207543.2018.1550271.
Griffin, A., Somermeyer, S., 2008. The PDMA ToolBook 3 for New Product Development. John Wiley & Sons. https://doi.org/10.1002/9780470209943.
Gross, J., Woelbert, E., Strobel, M., 2015. The fox and the grapes - how physical constraints affect value based decision making. PLoS One 10 (6), e0127619. https://doi.org/10.1371/journal.pone.0127619.
Gyimah, P., Appiah, K.O., Lussier, R.N., 2019. Success versus failure prediction model for small businesses in Ghana. J. Afr. Bus. https://doi.org/10.1080/15228916.2019.1625017.
Hamilton, R.W., Rust, R.T., Dev, C.S., 2017. Which features increase customer retention? MIT Sloan Manag. Rev. 58 (2), 79–84.
Han, J.K., Chung, S.W., Sohn, Y.S., 2009. Technology convergence: when do consumers prefer converged products to dedicated products? J. Mark.. 73 (4), 97–108. https://doi.org/10.1509/jmkg.73.4.97.
Harrison, S., 2007. The Cambridge companion to Horace. Cambridge University Press. https://doi.org/10.1017/CCOL0521830028.
Jain, S., 2019. Time inconsistency and product design: A strategic analysis of feature creep. Mark. Sci. 38 (5), 835–851. https://doi.org/10.1287/mksc.2019.1170.
Khanagha, S., Volberda, H.W., Alexiou, A., Annosi, M.C., 2021. Mitigating the dark side of agile teams: peer pressure, leaders' control, and the innovative output of agile teams. J. Prod. Innov. Manag. https://doi.org/10.1111/jpim.12589.
Knight, K., Robinson Fayek, A., 2002. Use of fuzzy logic for predicting design cost overruns on building projects. J. Constr. Eng. Manag. 128 (6), 503–512. https://doi.org/10.1061/(asce)0733-9364(2002)128:6(503).
Kulk, G.P., Verhoef, C., 2008. Quantifying requirements volatility effects. Sci. Comput. Program. 72 (3), 136–175. https://doi.org/10.1016/j.scico.2008.04.003.
Landis, L., Waligora, S., Mcgarry, F., Pajerski, R., Stark, M., Johnson, K.O., Cover, D., 1992. Recommended approach to software development Revision 3. NASA Goddard Space Flight Center - Softw. Eng. Lab. Ser. 〈https://ntrs.nasa.gov/citations/19930009672〉.
Liu, N., Yu, R., 2017. Identifying design feature factors critical to acceptance and usage behavior of smartphones. Comput. Hum. Behav. 70, 131–142. https://doi.org/10.1016/j.chb.2016.12.073.
Long, D., Morkos, B., Ferguson, S., 2021. Toward quantifiable evidence of excess' value using personal gaming desktops. J. Mech. Design 143 (3), 1–34. https://doi.org/10.1115/1.4049520.
Mafael, A., Raithel, S., Hock, S.J., 2022. Managing customer satisfaction after a product recall: the joint role of remedy, brand equity, and severity. J. Acad. Mark. Sci. 50 (1), 174–194. https://doi.org/10.1007/s11747-021-00802-1.
Marzi, G., Ciampi, F., Dalli, D., Dabic, M., 2021. New product development during the last ten years: the ongoing debate and future avenues. IEEE Trans. Eng. Manag. 68 (1), 330–344. https://doi.org/10.1109/TEM.2020.2997386.
Norton, M.I., Mochon, D., Ariely, D., 2012. The IKEA effect: when labor leads to love. J. Consum. Psychol. 22 (3), 453–460. https://doi.org/10.1016/j.jcps.2011.08.002.
Rahman, M., Manzur Rahman, M., 2009. To defeat feature fatigue the right way, understand it first. Strateg. Direct. 25 (6), 26–28. https://doi.org/10.1108/02580540910952190.
Repenning, N.P., 2001. Understanding fire fighting in new product development. J. Prod. Innov. Manag. 18 (5), 285–300. https://doi.org/10.1016/S0737-6782(01)00099-6.
Ronen, B., Pass, S., 2008. Focused Operations Management: Achieving More with Existing Resources. John Wiley & Sons.
Ropponen, J., Lyytinen, K., 2000. Components of software development risk: how to address them? A project manager survey. IEEE Trans. Softw. Eng. 26 (2), 98–112. https://doi.org/10.1109/32.841112.
Rust, R.T., Thompson, D.V., Hamilton, R.W., 2006. Defeating feature fatigue. Harvard Bus. Rev. 84 (2), 37–47.
Salvato, J.J., Laplume, A.O., 2020. Agile Stage-Gate Management (ASGM) for physical products. R and D Manag. 50 (5), 631–647. https://doi.org/10.1111/radm.12426.
Schmidt, J.B., Calantone, R.J., 2002. Escalation of commitment during new product development. J. Acad. Mark. Sci. 30 (2), 103–118. https://doi.org/10.1177/03079459994362.
Schmidt, R., Lyytinen, K., Keil, M., Cule, P., 2001. Identifying software project risks: an international Delphi study. J. Manag. Inf. Syst. 17 (4), 5–36. https://doi.org/10.1080/07421222.2001.11045662.
Shabi, J., Reich, Y., Robinzon, R., Mirer, T., 2021. A decision support model to manage overspecification in system development projects. J. Eng. Design 1–23. https://doi.org/10.1080/09544828.2021.1908970.
Shmueli, O., Pliskin, N., Fink, L., 2015. Explaining over-requirement in software development projects: an experimental investigation of behavioral effects. Int. J. Project Manag. 33 (2), 380–394. https://doi.org/10.1016/j.ijproman.2014.07.003.
Shmueli, O., Pliskin, N., Fink, L., 2016. Can the outside-view approach improve planning decisions in software development projects? Inf. Syst. J. 26 (4), 395–418. https://doi.org/10.1111/isj.12091.
Shmueli, O., Ronen, B., 2017. Excessive software development: practices and penalties. Int. J. Project Manag. 35 (1), 13–27. https://doi.org/10.1016/j.ijproman.2016.10.002.
Stock, R.M., 2011. How does product program innovativeness affect customer satisfaction? A comparison of goods and services. J. Acad. Mark. Sci. 39 (6), 813–827. https://doi.org/10.1007/s11747-010-0215-4.
Thal, A.E., Cook, J.J., White, E.D., 2010. Estimation of cost contingency for air force construction projects. J. Constr. Eng. Manag. 136 (11), 1181–1188. https://doi.org/10.1061/(asce)co.1943-7862.0000227.
Thompson, D.V., Hamilton, R.W., Rust, R.T., 2005. Feature fatigue: when product capabilities become too much of a good thing. J. Mark.. Res. 42 (4), 431–442. https://doi.org/10.1509/jmkr.2005.42.4.431.
Thompson, D.V., Norton, M.I., 2011. The social utility of feature creep. J. Mark.. Res. 48 (3), 555–565. https://doi.org/10.1509/jmkr.48.3.555.
Tranfield, D., Denyer, D., Smart, P., 2003. Towards a methodology for developing evidence-informed management knowledge by means of systematic review. Br. J. Manag. 14 (3), 207–222. https://doi.org/10.1111/1467-8551.00375.
Verkijika, S.F., 2021. Download or swipe left: the role of complexity, future-oriented emotions and feature overload. Telemat. Informat. 60, 101579 https://doi.org/10.1016/j.tele.2021.101579.
Wacker, J.G., 1998. A definition of theory: research guidelines for different theory-building research methods in operations management. J. Oper. Manag. 16 (4), 361–385. https://doi.org/10.1016/s0272-6963(98)00019-9.
Wouters, M., Workum, M., Hissel, P., 2011. Assessing the product architecture decision about product features - a real options approach. R and D Manag. 41 (4), 393–409. https://doi.org/10.1111/j.1467-9310.2011.00652.x.

Wu, M., Wang, L., Long, H., Li, M., 2015. Feature fatigue analysis in product development. Total Qual Manag. Bus. Excell. 26 (1–2), 218–232. https://doi.org/10.1080/14783363.2013.860697.

Yin, M., Meng, D., Zhu, D., Wang, Y., Jiang, J., 2021. Predicting changes in user-driven requirements using conditional random fields in agile software development. IEEE Trans. Eng. Manag. https://doi.org/10.1109/TEM.2021.3083513.

Yu, A.S.O., Figueiredo, P.S., De Souza Nascimento, P.T., 2010. Development resource planning: complexity of product development and the capacity to launch new products. J. Prod. Innov. Manag. 27 (2), 253–266. https://doi.org/10.1111/j.1540-5885.2010.00713.x.

Further reading

Marzi, Giacomo, 2022. Uncertainty-driven Innovation. Managing the New Product Development Processes in an Unpredictable Environment. Springer Nature, London. In preparation.

Giacomo Marzi is Assistant Professor (Tenured) in Management at the University of Trieste (IT), Department of Management, Mathematics and Statistics (DEAMS). Previously he was Senior Lecturer in Strategy and Enterprise at the University of Lincoln (UK), Department of Management where he now holds a Visiting Fellow position. He received a PhD in Management from the University of Pisa, School of Economics and Management, Italy. His primary research fields are Innovation Management, New Product Development, Strategic Management, and Entrepreneurship. Author of three books and several papers appeared in journals such as Technovation, Journal of Business Research, IEEE Transactions on Engineering Management, Human Resource Management Journal, International Journal of Production Research, and Scientometrics among the others. His work has also been presented at various conferences including Academy of Management, European Academy of Management, British Academy of Management, IEEE TEMSCON, and Innovation and Product Development Management Conference.