An analysis of serendipity in NPD: six cases

Abstract. Serendipity is widely recognised as an important feature of innovation management practice, and yet it is not yet the subject of systematic study. We analyse six cases of serendipity in innovation and identify activities which increase the likelihood of serendipity. We develop a model of serendipity in NPD. We suggest process, environment, and people as three important organizational elements of managing for serendipity during new product development. We contribute to innovation theory and show serendipity as an organisational capability in the NPD process.

Keywords: New Product development; Serendipity; innovation.

1 Objectives and theoretical and practical relevance

Serendipity, the discovery of something unexpected and beneficial [1] has been described as the most important driver of disruptive innovation [2]. Whilst serendipity is now an explicit feature in some policy settings [3] it appears absent from models of new product development (NPD). How can firms modify their NPD practices in order to increase the likelihood of noticing and benefitting from serendipitous events?
We analyse six cases of serendipity in innovation and identify activities which increase the likelihood of serendipity. This paper conceptualises serendipity in NPD, and embeds serendipity as an organisational capability into the NPD process.

2 Brief literature mapping and key references

Serendipity is routinely, but mistakenly, considered synonymous with luck, and it remains comparatively under-researched [4]. In our initial literature review we find serendipity has rarely featured in NPD research (see e.g. [5] and [6]. Serendipity has been studied in related domains such as scientific interactions [7], information retrieval [8], entrepreneurship [9] and management studies [10]. Some important theorisation has also taken place in organization studies [1;4;11]. Eschewing notions of luck and good fortune, we define serendipity as *the process of learning unexpected information through informed speculations based on detailed observations.*

We find that serendipity is widely recognised as an important feature of innovation management practice, and yet it is not yet the subject of systematic study. Positioned in contrast to operational excellence, which requires analytical precision, “innovation calls for variation, failure, and serendipity” [12]. Serendipity is a regular feature of emergent discoveries that arise during the innovation process, such as the unexpected learning that occurs during the process of prototyping [13], during ethnographic

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research [14], or during informal workplace conversations [15]. Serendipity is also an important factor enabling very long product life cycles [16].

One plausible reason for why serendipity is not approach as something that can be managed is that the concept is understood as 'unanticipated luck'. As examples, serendipity is important for post-launch product success but cannot be predicted [16]. In a discussion about managing beneficial network effects, serendipity is positioned in contrast to foresight [17]. It is also observed that the drug development process is subject to "extremely high uncertainty and occasional serendipity" [18]. None of these three papers offers any specific advice on how to manage for serendipity. Another paper positioning serendipity as unanticipated luck does offer some advice, suggesting that serendipity should be incorporated through organisational agility, but this is a passing mention with no further elaboration [19].

3 Theoretical development and research question

The word "serendipity" was coined by the British writer Horace Walpole in 1754. The term was relatively dormant until introduced into the sociology of science by Robert Merton in 1945 when he defined it as: "The common experience of observing an unanticipated, anomalous and strategic datum which becomes the occasion for developing a new theory or for extending an existing theory" [20].

Whilst common usage still implies good fortune and luck, the academic literature emphasises sagacity [21;22] as a central element wherein solutions are brought about by purposeful action: "…Accidental discovery is not a synonym for serendipity… Discoveries occur when you are looking for something—with your eyes wide open…" [9]. NPD managers are advised to avoid the notion that serendipity is good fortune alone, but instead "a practical accomplishment rather than an organizational form of mystery [11].

It may be useful at this juncture to underscore that the purposeful activities of serendipity as the pattern of such discoveries is a process determined by observational skills. That the observation is unexpected or anomalous and sometimes surprising, is either because it seems inconsistent with prevailing theory or with established facts. In either case, the seeming inconsistency provokes curiosity; it stimulates the investigator to make sense of the occurrence. That is, to use existing knowledge to offer a plausible explanation [23]. This is usually achieved using inference to understand and explain the observation. For example, in a detailed analysis of Pasteur's scientific experiments, Vantomme and Crassous [24] describe how Pasteur was able to make deductions from his observations because of his unusual education and training. Frequently, these observations were unexpected, and he was astonished. His exceptional experimental abilities also enabled him to imagine interpretations and build understanding. In their research on theory building Sætre and Van de Ven [25] argue that serendipity should be viewed as part of the normal process of scientific discovery. They maintain that within scientific research there will always be unexpected outcomes as part of the

curiosity of enquiry. Thus, serendipity alone does not drive creativity, but in the absence of a prepared mind the opportunity that serendipity affords is missed [25].

The publication of Merton and Barber's (2004) book The Travels and Adventures of Serendipity seems to have led to a shift of interest in scholarship focusing on serendipity (e.g. [21] and [26]). Robert Merton's interest in serendipity began in the 1940s and over a period of several decades led him to chart its lexicographical history. In his theoretical analysis of the concept of serendipity Yaqub [1] takes Merton's extensive notes as a starting point and shows that serendipity can arise in different forms and in a variety of ways. Yaqub's aim is to clarify the meaning of the term 'serendipity' by drawing attention to the heterogeneity of the phenomenon. Having thematically analysed Robert Merton's extensive archive he elucidates a 2x2 typology comprising four ideal types of serendipity.

Formal product development processes are inadequate without 'soft' factors such as goodwill and negotiation [14]. Thus, we examine: How can firms modify their NPD practices in order to increase the likelihood of noticing and benefitting from serendipitous events?

4 Research Approach

Given that serendipity appears absent from models of new product development (NPD), we had to select an appropriate approach to address our Research Question: How can firms incorporate serendipity practice into their corporate NPD processes? We adopt an abductive research approach, which is valuable when the existing literature does not offer a clear theoretical foundation for understanding empirical patterns and, hence, the specification of hypotheses in advance is not possible [25]. Sætre and Van de Ven [25] propose a model of abductive reasoning that involves several stages and an iterative process, starting with the observation of an anomaly: in this case the absence of serendipity in NPD. Abduction is a form of inference that seeks to use available information to arrive at a set of plausible, but not definitive, conclusions [27; 28]. Given that it is theoretically unclear a priori, if and how, different knowledge sources will shape the use of serendipity inputs; abduction is a suitable approach for our study, as it allows us to draw upon the patterns revealed by our cases, the extant literature, and limited theoretical perspectives to suggest plausible explanations for the behaviours and NPD patterns observed. Furthermore, the process of abductive reasoning lends itself to conducting research on technology by focusing on action, exploration, collaboration, dissemination, and creation as suggested by [29].

Our six case studies are historical. We follow Murmann's [30] call for historical research to "build deeper conceptual understanding by carrying out detailed empirical case studies about the causal processes driving a phenomenon." In this paper we present the results of six separate case studies on serendipity in new product development. The cases were selected from a larger collection of historical cases of serendipity (see Appendix 1). This large collection of historical cases was generated from a systematic search of the databases of the main scientific literature namely: Scopus; Science Direct

and EBSCO. It is from this population that we have selected six cases using purposeful sampling. Each case represents a different stage of the innovation process.

5 Findings

The six cases shown in appendix 1 have some differences, such as identifying unexpected effects (1,3,4), and unsought properties (2,3,6). All of them rely on 'unexpected learning based on detailed observations'. The NPD projects vary, and some completely reframe the NPD project based on these insights (1,4,6) and others begin a new NPD project to develop these unexpected discoveries (2,3). Building on insight from these cases we develop a model of serendipity in NPD that includes NPD process, NPD environment, and NPD people as three critical elements (see Figure 1).

5.1 Process

If serendipity is an unsought finding during NPD activities then positioning serendipity as a process is a paradox since it implies searching for the unsought, or engineering chance. And yet, in a scientific setting, the active pursuit of serendipity can result in better research quality.

5.2 Environment

The wider organisational environment and cultural norms of the organization will influence the likelihood of serendipitous discovery. Rigid planning restricts serendipity, informal structures promote it, and a cooperative climate and a non-conformity orientation may serve to keep innovation managers open to the unexpected.

5.3 People

Capability is a core aspect of *the prepared mind* [24, 25]. This has been called *sagacity*, the abilities of acute perception and connection-making [32]. Individual capability has also been called *strategic knowledge serendipity*: "the capacity to identify, recognize, access, and integrate knowledge assets more effectively and efficiently" [33].

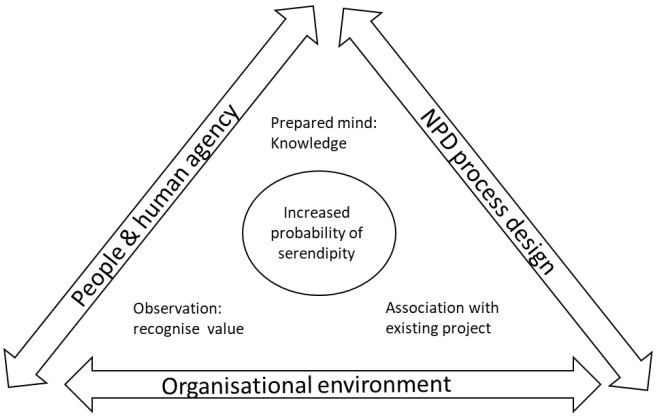

Fig. 1. Three necessary dimensions for serendipity in NPD.

6 Conclusion and contribution to the field

We have argued in this paper that firms need to develop capability within their new product development processes that enable discoveries to happen. Such an enhanced NPD process will provide the space for people to explore and diverge from their original plans, to take risks and to fail [24]. Serendipity is able to play a supporting, but essential role in NPD, that should not be underestimated or exaggerated. The implications of our thesis here in this paper is to challenge some of the assumptions on which the prevailing market-oriented R&D governance models and policies are based. We develop a more contemporary innovation theory which embeds serendipity as an organisational capability into the NPD process.

7 Managerial implications

On the basis of our findings from our cases of serendipity we propose implications for the management of NPD.

Serendipitous events require agency, surprise and value [34]. Identifying value and being surprised are related to human capital, and to some extent the keen skills of observation and association necessary for serendipity [23] can be recruited for. Agency relates to process design, autonomy, and decision rules, and so NPD strategy must specifically allow for individual freedom, autonomy and agency (including budget, since many NPD activities will require equipment and supplies) to pursue weak signals.

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Appendix 1: Technology innovations alleged to be due to serendipity

No	Innovation	Occurrence	Source(s)	Where in the innovation process?
1	Viagra	Sildenafil was originally developed to treat cardiovascular problems by dilating blood vessels in the heart. Unexpected side effects were discovered.	Goldstein I, Burnett AL, Rosen RC, et al. The serendipitous story of sildenafil: an unexpected oral therapy for erectile dysfunction. Sex Med Rev 2019;7:115-128.	NPD: Stage 1 clinical trials
2	3M Post-it note	A scientist at 3M had been studying strong adhesives and developed one that was not very sticky. Later, a colleague found a novel use for it.	Havener, C. (1994). An insider's guide to the Post-it Note story. *Management Review*, *83*(12), 45.	NPD
3	Microwave oven	Percy Le Baron Spencer was a physicist at Raytheon in the US, in 1945 he was studying the high-powered microwaves emitted by an active radar set when he noticed that a chocolate bar in his pocket had melted.	Osepchuk, J. M. (1984). A history of microwave heating applications. *IEEE Transactions on Microwave theory and Techniques*, *32*(9), 1200-1224.	R&D: Applications engineering
4	Superglue	In 1942, a team of scientists headed by Harry Coover Jr. stumbled upon a formulation that stuck to everything with which it came in contact.	Berger, A. A., & Berger, A. A. (2018). Superglue. Perspectives on Everyday Life: A Cross Disciplinary Cultural Analysis, 163-165.	NPD
5	Kevlar	Kevlar, otherwise known as the material in bulletproof vests, was created by chemist Stephanie Kwolek in 1965.	Tanner, D., Fitzgerald, J. A., & Phillips, B. R. (1989). The Kevlar story—an advanced materials case study. *Angewandte Chemie International Edition in English*, *28*(5), 649-654.	R&D: Applications engineering
6	Bakelite	In 1907 Leo Hendrik Baekeland accidentally created Bakelite. His initial quest was to invent a ready replacement for shellac, an expensive product derived from lac beetles.	Bijker, W. E. (1987). *The social construction of Bakelite: Toward a theory of invention* (pp. 159-187). Cambridge, MA: MIT press.	R&D