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Production Phase-Out During Plant Shutdown

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Abstract

Today's industry environment is characterized through a very unpredictable market. Therefore, companies establish robust production and logistics systems [1]. However, sometimes the established robustness does not prevent companies from location dynamics, including plant shutdowns or plant relocation [2]. Then, particularly, when big companies are involved and plenty of jobs are at risk, the public pressure is immense [3], which requires an effective management. Even though the market forces are obvious, the research intensity related to plant shutdowns is comparably low [4]. Appropriate expertise can be gained especially for the production phase-out (a repeated procedure), which is the operative implementation of every plant shutdown, but also takes place during standard product elimination.
The paper's aim is primarily to conceptualize the different plant shut-down options. Second, it targets on analyzing how the production phase-out and the plant shutdown are organized in industry and to investigate if and how these processes can be standardized to avoid inefficiencies. In-depth expert interviews have been conducted. A purposive sampling strategy was followed including companies ex-post to their plant shutdown caused by insolvency, consolidation, offshoring, divestment/product elimination and outsourcing. Based on the empirical results, the relation between production phase-out and plant shutdown is emphasized. The evidence results in a framework of plant shut down reasons and concluding processes. The further developed process for production phase-out during a shutdown displays a form of guideline for companies.

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1. Introduction

Globalization, raising customer demands, as well as shortened product life cycles are significant current trends of supply networks [5]. In order to meet those requirements, companies start to build stable and flexible supply networks. Especially in mature industries, where the customer's bargaining power is relatively high and a declining demand is faced by the companies, industry needs to provide robustness.

Sometimes the company's robustness does not prevent from declining demand leading to plant downsizing [6], which may result in closures [7]. Extending the downsizing definition of Cascio [8], we define the *plant shutdown as the planned elimination of an entire plant site, thus terminating all production and the production-related activities including the cleaning of the shop-floor and the associated warehouses*.

In early literature, plant closures were seen as ultimate and negative option, sometimes named 'corporate restructuring' causing mass lay-offs and economic challenges at the regional and local level [9]. Even though closures in a single plant firm indicate a failure, plant shutdown in a multi plant firm may be a route to business success [10]. Simultaneous to facility closures, new ones start and the shifts need to be regarded as normal business alternative. Linking shutdown to project management makes ending a natural phenomenon [11].

Nevertheless, companies, despite already having accomplished several plant shutdowns, do not have any structured approach, nor even a contact person with knowledge and experience giving advices [12]. Companies need an ending-competence, including managerial skills beyond day-to-day business [11]. Thus, we intend to develop a shutdown process basing on the four production factors. The process includes activities to be performed in

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the operative environment of the production. Having defined process stages and underlying activities, clear shutdown goals can be set, thus making benefit from the closedown effect [13], an increase in productivity and improved quality without any change of capital investment during shutdown plant [14]. Furthermore, we conceptualize different closure alternatives through analyzing German companies' shutdowns.

For defining a common starting point and a process, which is repeatedly performed in every company, not only during closure, we take the production phase-out. We define the phase-out as follows: *Production phase-out is a process, enabling a company to terminate a product's production at a certain plant. Starting after the phase-out decision, it ends with the finalization after the end of production.*

The remainder of this publication is as follows: section 2 analyzes the literature on plant shutdown and production phase-out. Section 3 describes the methodology applied. Section 4 deals with the conceptualization of shutdowns, followed by the process model elaboration in section 5. The final section 6 discusses the results, explains the contribution to research and management and gives an outlook on further research.

2. Literature Review

2.1. Plant Shutdown

The plant shutdown (or plant closure) literature's extend is very limited. Most authors focus on the employee's perspective. The existing publications deal with aspects such as union organization [7], social [9] and psychological [15] consequences of workers relocation.

Despite that research focus, there is a second trend, investigating why plants need to shut down [10], which characteristics make it more likely for a plant to be closed [16–18] and how to predict those happenings [6]. Furthermore, strategic considerations (e.g. divestment or market exits) are explored [19], and downsizing, without incorporating the shut-down is regarded [7]. For example, firms must carefully evaluate the national and local circumstances [20], e.g. the economic situation.

The first two publications actually dealing with the management of shutdowns are two articles of Janssens and Vansina-Bobbaert [21 & 22] out of which the first one describes a shutdown problem and the second one develops solutions. The authors elaborate different "go's" and "no-go's", especially regarding the employees' treatment. They also consider aspects regarding the quality control and the production machines. All solutions they provide follow the target of keeping the production as the same quality and quantity output as before plant closure announcement.

The third publication relevant for managing closures relates managing a shutdown to project management [11]. The authors' focus is on ending the business relations with suppliers, through developing an ending competence for the company's employees.

To the best of our knowledge, there is only one publication elaborating a shutdown management system. Butler et al. [12] studied the case of Vauxhall Motors Luton when it was closed in 2002. The authors develop a facility closure management model containing a five stages approach including stage activities: (1) managing corporate brand name / legacy, (2) managing communications, (3) managing closure, (4) managing investment in employees, and (5) managing continuity of operations. It is depicted in figure 1.

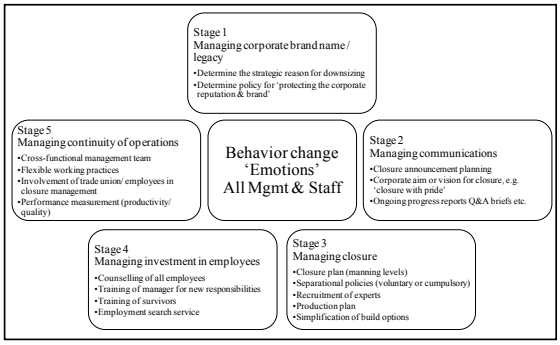

Fig. 1: Model of facility closure management [12]

From the depicted activities within every shutdown stage, not every single one is relevant for production. Only the 'production plan' of stage 3 indicating the need for a capacity planning for the period from shutdown announcement to the end of production, and the 'performance measurement' of stage 5 which intends to monitor the plant performance, target on operations management. Furthermore, the stages do not seem to be subsequent ones, they more aggregate different managerial tasks under certain headings.

As described above, mostly the human perspective is deeply investigated. Management approaches can be found seldom or on a very abstract level. The remaining production factors – material, and machines including equipment and facilities according to [23] – are not touched in any publication. Apart from this limitation, shutdown research focuses on marketing and strategic management. Also the empirical evidence can be criticized, since all shutdown management articles are based on a single-case study approach. Furthermore, incorporating the consequences, so to say what is happening after the end of production is not explained.

However, one research area related to the plant closure is the so-called product elimination literature. It deals with the production-oriented view on a product to be eliminated and how production can phase-out this product. The link is that during factory closure, the production necessarily has to be phased-out. Within this literature, we expect to as well gain insights for a phase-out during plant shutdown. Since no literature is available for the specific case of phase-out during a plant shutdown, we will subsequently analyze the general phase-out literature.

2.2. Production phase-out and product phase-out

In literature, the product phase-out deals with the implementation of a product elimination decision [24]. It is the process enabling companies to not produce a product anymore. The product phase-out is subsequent to the product elimination decision and starts with the planning. The product phase-out ends with the finalization after the end of production [25].

The production phase-out, which we defined in section 1, slightly differs from a product phase-out. For example, the Volkswagen AG (VW) shifted the entire "Käfer" (=Beetle) production to Mexico in 1964. Therefore, the German production was phased-out, while the car was still available to the market until 1985. Thus, the product was not phased-out. For a shutdown, the production phase-out is relevant, since companies might shift their production to another plant site.

Different product phase-out processes were developed, which were aggregated to a generic model in [25]. This process contains four stages – planning, implementation, control, and finalization. However, the existing phase-out literature only deals with the product phase-out, not including production phase-outs. Reflecting the phase-out literature analysis given in [25], no phase-out article includes the shutdown option. Furthermore, most publications are written in German, so the other researchers' access to their results is limited. In addition, their findings are not deeply validated (using only single case study methodology) and are limited to two branches (automotive and electronics industry).

3. Research Gap and Methodology

The literature review presented in chapter two shows two main gaps in research. First, it is not clearly known what consequences result out of the plant shutdowns. Reasons for the closure are described to be efficiency problems, not describing what happens to the different production factors after the closure. This results in the first research questions:

1. Do different shutdowns show individual reasons and consequences?

Second, the phase-out process for shutdowns is not clearly defined. This comes along with only one-dimensional investigations (i.e. only on the employee's perspective in the shutdown literature and on the product perspective by the majority of the phase-out literature). However, the phase-out process's quality is proven to create a company's performance increase [26]. Thus, the second research question is as follows:

2. How does a holistic process for production phase-out during plant shutdown look like?

Our study aims at first proving a framework on shutdown reasons and consequences. We attempt to give a broader insight into the shutdown beyond the efficiency problem. Our second target is to develop a shutdown phase-out process and its underlying activities. The research questions address the gap of a holistic shutdown understanding. Therefore, the qualitative methodology represents an appropriate fit among the research questions (how) and the prior theory (nascent) [27], [28].

Since the investigation is exploratory in nature, we selected eight in-depth cross sectional interviews with companies producing in Germany or German-owned companies. We purposively selected experts from companies obtaining different phase-out strategies during their closure. Data was collected through in-depth and semi-structured interviews (with experts from different departments such as production, marketing, and product portfolio managers). Interviews were conducted on-site, recorded, and then transcribed in full-length to enhance data analysis effectiveness. Additional company internal documents were requested, which could support the results coherence (multiple sources of evidence and literature cross-check). Table 1 shows companies' characteristics.

Table 1: Interview companies' characteristics

Firm	Branch	Products	Phase-out Strategy
S	Storage equipment	1 (+ variants)	Immediate phase-out
T	Medical products	several	Slow phase-out
U	Paper industry	5	Slow phase-out
V	Electricity industry	1	Immediate stop
W	Carrier vehicles	5 (+ variants)	Planned slow phase-out but immediate stop caused by strikes
X	Construction material	1 major	Only modifications
Y	Storage vehicles	1 (+ variants)	Slow phase-out
Z	Construction site equipment	3 (+ variants)	Slow phase-out

In this study, the quality of the research design is ensured through the use of multiple sources of evidence in the data collection. We performed within-case analysis and cross-case pattern matching, the cross-check of the results to ensure internal coherence of findings along with a rigorous study protocol including objective, selection criteria, sample description, respondents overview, data collection and data analysis techniques and interview blueprint.

4. Shutdown conceptualization

In literature, the shutdown reasons are described to be resulting out of plant efficiency problems [17]. However, our sample reveals additional insight. We detected shutdowns induced by efficiency difficulties and causing insolvency, consolidation, divesture, and offshoring, and outsourcing. Furthermore, there are two different alternatives, for what happens afterwards with the product, it can either be disposed, or its manufacturing is relocated. Creating a matrix out of the reasons and the consequences it is possible to map the interview shutdowns (table 2). As a matter of fact, there is no example for the field of offshoring-disposal. The underlying intention of offshoring is to manufacture the product in another region, so it is not subject to disposal or elimination. Additional information to each interview can be found below the table.

Table 2: Shutdown framework

	Disposal	Relocation
Insolvency/ efficiency	X, Y	W
Consolidation	U	U, Z
Divesture	V	
Offshoring		T
Outsourcing	S	S

S: The company strategically decided to leave the market and found a supplier which took over the product's rights. The facility and equipments were disposed. The remaining stocks and the tools were sold to the supplier. Therefore, the case fits to both consequences. The company still has the product in its portfolio, which is now purchased from the supplier.

T: The relocation is targeted, but due to legal constraints emerged in the offshore region, the transfer is not finalized by now. Therefore, the German factory still is producing.

U: Two out of the three products manufactured were transferred to a sister plant while one was eliminated from the company's portfolio. The machines were entirely disposed in order to avoid new market overcapacity due to a competitor buying it. Thus, this shutdown is placed in the disposal as well as in the relocation rectangle.

V: The closure of this plant site was due to a legal change, so a strategic divesture became obligatory. Because of a special production environment, it is not possible to relocate any of the materials or machines.

W: It was not intended to close the plant site; a consolidation without reducing the staffing level was planned. However, the employees started striking which caused the factory's insolvency.

X: The product was already produced at different plant sites, so no relocation was necessary. Furthermore, the equipment was very old and could not be sold.

Y: It was planned to dispose everything, since the company decided to divest including a market exit, but one week before closure, the plant site was sold and left open.

Z: Due to the consolidation, the equipment and machines were not needed at the alternative plant site. They were sold to an Asian company which also supervised the deconstruction and the shipping preparation.

Resulting, it can be stated that beyond the rough description of efficiency problems mentioned in literature, there can be found more information regarding closure reasons and resulting consequences. Following, we look at the shutdown process with a focus on the phase-out for revealing further insights.

5. Phase-out process during shutdown

Factory shutdowns are "difficult, delicate and painful tasks" [22]. However, they are becoming more frequent in today's business. This makes a shutdown process necessary, where the responsible managers can rely on. Meeting the production output quality and quantity goals by keeping the production stable is one of the main production targets, even during closure. Also, strikes (or even plant occupation) can be avoided through managing termination [21]. Since a production phase-out is the operative shutdown implementation across different closures, it can be taken as a starting point. A phase-out process includes four stages (1) planning, (2) realization, (3) control, and (4) finalization starting from the decision [25]. The shutdown decision is regarded as milestone before the process starts, thus it is not included into the investigation. At that decision point, closure is inevitable, no other options, such as sale or transfer, are remaining [11]. The following planning stage is linked to the first three stages described by Butler et al. (managing corporate brand name, managing closure, and managing closure). The realization stage is related to stages 4 and 5 (managing investment in employees, and managing continuity of operations) [12]. Furthermore, we add the process stages of control and finalization, because monitoring supports achievements reflection and after the end of production, the finalization takes place, which indicates the end of all support activities.

For the entire process, the four production factors man, machine and material, plus the management are taken into account. All activities described for the different shutdown process stages are depicted in table 3. For this new process we focus on the interview results. Therefore, activities mentioned by the experts were extracted and listed. Since the study is explorative in nature we did not count or weight any of the activities. For providing a complete framework, we also included activities mentioned in literature.

Even though we now present four different process stages for the production factors, we need to leverage the insights. As stated by expert Z, the human labor as production factor is the most important one during a plant shutdown. This factor is followed by the factors material and machine.

Furthermore, it needs to be highlighted that only company V uses any means for controlling and monitoring. All other companies did not reflect their behavior. Therefore, only few activities are mentioned.

Interestingly, the shutdown phase-out period differs between literature (6 weeks - 1 year [11, 29]), and interview results (12 to 18 months). The difference might be caused by stricter laws. I.e. to dismiss employees in Germany is complicated and time-consuming and unfair dismissals often cause lawsuits with a high financial insecurity [30]. Therefore, the closure duration is could be higher.

Whether or not the shutdown process depends on the shutdown reason cannot be stated at this early point of investigation. However, it is worth noting that especially the finalization stage activities depend on the consequences. For example, "send expert to new facility" or "machine shipping" only account true for relocation situations.

Table 1: Holistic phase-out process and activities during plant shutdown

	Planning	Realization	Control	Finalization
Man	• Defining clear responsibilities [21], cross-functional team (X, V), gather experienced members (W) • Elaborating redundancy programs [11] developing motivation plan (T) • Preparing for unknown tasks [11]	• Informing personally, avoid media leaks [11] • Replacing people who left the company ([21], U) or adopt plans (X), keep production running, even without engineers (U) • Motivating employees, create sense of „shared ownership“ ([21, 22]), give clear tasks (Z) • Giving responsibility to workers [21] • Offer the employees contact persons for working through worries [22] • Continuing extra-production activities (e.g. jubilees) as normal [22] • Avoiding absence and „playing sick“ [22], asking for sickness certificates (Z) • Defining group leaders with shop floor authority instead of managerial imposed authority (shifts of frontier of control) [14] • Reducing employee capacity while reducing machine capacity (Z, T)	• Replacing people who left the company [21] • Providing short-term feedback on quantity and quality [21] • Performing motivation survey (V)	• Working of lost days for those workers who have been proven to „play sick“ [22] • Clearing working space „parting-day“ to take leave from things [22] • Having a get together including plant manager [22] • Parting gift as token of gratitude [22], remuneration (Z) • Job-finding assistance after closure [22] • Keeping key personnel after closure for supplier relationship ending [11] • Transferring employees to sister plant (U,[7]), train them for other jobs, (early) retirement, or other companies [7], transitional company (Z) professional education, qualification (X), shift to sales and after sales /maintenance organization (W) • Developing closure team (U) • Keeping HR personnel until the finalization end in order to make contract changes or pay overtime (U) • Sending expert to new facility in relocation situation (T)
Machine	• Including potential sabotage into coapacity planning [22] • Applying for closing permissions (U) and deconstruction permissions (V) • Performing environmental impact audit, informing public and public discussion (V	• Explaining any delay reasons (e.g. for maintenance or repair) for showing that it does matter [22] • Avoiding capital investments [14], but ensure maintenance (S) • Watching machines carefully but in a descrete way [22], hiring security guards if needed [14] • Reducing capacity, e.g. due to lack of personnell (U), or planned from to shift to one shift system (S), eliminating redundancies (T)	• Measuring sabotage occurrences [22] • Ensuring safety for employees and residents through continuously monitoring (V) • Guarantee fire protection (V)	• De-activating facility [7], machine deconstruction and shipping preparation (Z) • Installing locks to secure the building [7], plant dismantling and material recycling (S,X) • Selling, disposal, revitalization of machines (Z), selling to strategic suppliers (W) • Relocating machines to new production sites (as pull transfer) (Z, T) • Cleaning plant site and warehouse (Z), clean machines (U) • Ensuring facility/environment safety during deconstruction (V) • Searching for further utilization of buildings (W)
Material	• Producing especially products the employees like to manufacture [21] • Including potential sabotage into material planning [22] • Assuring continuous product support, supply components [11] • Developing output plan [11], materials planning for remaining stock minimization (U) • Launching last time buy request (W) • Planning spare parts (W, Z), 3rd party manufacturer (Y) / within company (W) • Investigating legacy of pollution and their clean-up (register of polluted sites) (U) • Planning remaining stocks treatment, especially for polluted materials (V) • Offering replacement product to customer, incl, new requirements (W)	• Arranging the delivery end with suppliers (aligning different lead times) (W) • Avoiding high number procurements (Z), adopting procurement to output plan (X) • Not repairing defect items (Z) • Reducing storage quantity and service level (S), Consider minimum order quantities (W)	• Adding an extra share in quality testing [22] • Thievery and according punishment [22] • Measuring sabotages [22]	• Remaining stocks treatment, e.g. recycling, disposal, storage, sale (Y,Z), transport to sister plants (X) • Offering a new generation replacement and financial support if customer wants an old product (Z)
Manage-ment	• Offering maximum information ([21], S), communication training (Z), press releases & timely information (X), involving stakeholders (V) • Searching job alternative, e.g. (pre-) pension, other companies [21], suppliers (W), sister plants (U), other company parts (S) • Avoiding strikes and plant occupation [21], include unions [7], inform work council (Z), avoid destructions (W) through providing future perspectives (S) • Acquiring knowledge through consultancy companies ([11], T), or internals with previous experience (V) • Contacting supplier and negotiating remaining stocks [11], rental termination (Z) • Protecting brand [11], including politicians (Z) • Pre-informing key suppliers before official announcement [11] • Including EU to avoid charges for public funding [20] • Explaining in detail why a certain plant is closed [20], develop common understanding (X), give detailed analysis (Y) • Develop strict timeline (Z), harmonize shutdown with contracts (Y) • Transferring products and knowledge to sister plants, incl. customer transfer (U), sell product‘s rights to another company (S) • Preparing claims reserves (V), fix clear targets (e.g. cost minimum) (S) • Deciding for phase-out strategy [31], define processes, principles and rules (S) • Considering supplier insolvencies and similar side effects (T)	• Being present and taking care for shutdown-induced personal problems [21], executing regular plant walk-throughs [11] • Assisting employees with recommendation to future employers [21] • Being prepared for strikes and plant occupation [21] • Listening to anger outbursts and only replying to rational issues [22] • Ending supplier relationships carefully, preparing with facts [11] • Coordinating contacts with politicians and media [11] • Requesting for lawyer‘s advices [11] • Aligning production phase-out with relocation ramp-up (S)	• Supervising the decrease in total production [21] • KPIs for deconstruction (V) • Checklists (W) • Cost calculation, shutdown budget (S) • Ensuring schedule matching (T)	• Elaborating final report describing the whole process [11], standardizing processes (S) • Finalizing relationship closures [11] • Making the ended supplier relations re-activable [11] • Lessons learned (W, U) and documentation (not only in German) and report, and spread the knowledge (U) • Transferring product‘s rights (S, T)

6. Conclusions

During the last decades, many companies were obliged to downsize their production capacities [19]. Some of those corporate restructurings resulted in shutdowns. As closures become more frequent, being more than legal contract termination, through involving also great moral considerations [11], an ending competence needs to be developed. In order to ensure appropriate behavior, 5 out of 8 interview partners regard standardized processes as adequate.

With this research we decreased the huge gap in the shutdown literature. We developed a closure framework depicting different closure alternatives in terms of reasons and consequences. So, we detected additional shutdown reasons apart the efficiency problem.

Subsequently, we elaborated a process model mapping the different shutdown stages, for the phase-out being repetitive for every closure (W). Resulting from the conducted in-depth interviews and the scarce literature available, we developed for every process stage a plan highlighting activities for the individual production factors.

Even though the literature already stated that plant shutdown knowledge should be included into a company's risk management practice, in none of the interview experts' companies it was practiced. Plant managers, who often are obliged to execute a decision made by upper management, are additionally obliged to keep with production goals and quality targets (mentioned in 6 of the interviews). Two experts expect shutdown costs (ca. 20-30 Mio €) to decrease with standardized procedures, thus, our process description with the activities will help companies to decrease losses (U, W). In addition, a standardized process supports the planning time reduction (S). In this regard, the shutdown framework especially supports the planning stage of the shutdown process.

Obvious limitations come from the small sample size and the exploratory investigation (the German Ministry of Statistics refused to provide us country-wide closure data due to privacy reasons). This study is cross-sectional, but one-dimensional focusing on German companies. Generalizability can only be achieved with further standardized extended sample surveys. The process framework presents all activities which have been mentioned in a comprehensive overview. Further research should detect new, prove identified, and rank the importance of process activities. In addition, our assumption that standardization supports the closedown effect exploitation needs to be validated. Especially a large-scale investigation which should also detect further links between the shutdown reasons and the activities to be performed is promising.

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