Using System Analysis and Information System Development for a Manufacturing Process

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Abstract: - The purpose of this work is to illustrate an exercise in system analysis and information system (IS) development to make a process of cigarette production streamlined, with a specific focus placed on a machine packer. The illustration shall utilize a specific cigarette packing machine. By employing system analysis and IS development, the research aims to illustrate the effect of such methodology to the overall improvement of the entire process of cigarette manufacturing. This work forms the basis for future research on integrating emerging technologies like machine learning and Industrial Internet of Things (IoT) for further enhanced monitoring and inspection of the process of packing cigarettes.

Key-Words: - Manufacturing process of cigarettes, system analysis, information system development, SADT, OOPP, packer machine.

Received: July 15, 2024. Revised: January 17, 2025. Accepted: March 5, 2025. Published: April 1, 2025.

1 Introduction

As the process of manufacturing cigarettes is a multi -step process, packing machine has a significant role to play in quality and efficiency. Secondly, the above example illustrates how system analysis and information system development assists in enhancing a cigarette machine packer, [1]. According to the system analysis, an IS can be designed to: (1) monitor machine performance in real time, capturing production speed, downtime, and potential quality issues. (2) give warning of maintenance requirements, allowing preventive maintenance and reducing downtime, [2]. (3) improve data collection and reporting, allowing monitoring and analysis of production, [3].

The study acknowledges the public health concerns associated with tobacco products. The focus remains on applying technical expertise to improve a specific manufacturing process, not promoting tobacco use, [4].

In this paper, we present a case study for the improvement of the reliability and availability of a group of production. It is why we first present the process of making cigarettes, then the diagnosis of the existing to determine the most critical machine within the company. Then, we present two analysis methods SADT and OOPP. Finally, we present an Analysis and improve maintenance of the machine packer cigarettes.

2 Manufacturing Process of Cigarettes

The process flow diagram is intended to view the main steps of a process, [5]. It is a means of communication to apprehend, analyze, normalize, and develop the process. During this diagnosis, we have identified the location of each equipment: operating equipment and transport workshop equipment, [6]. The tools used in this work for the improvement of the process will be subsequently universal on all equipment of the factory after confirmation of the expected results of this methodology, [7]. That is why we found the machine packer of the cigarettes in this workshop production line is the most critical machine in the factory, [8].

Figure 1 (Appendix) shows the process of the manufacture of the cigarettes.

3 Presentation of SADT and OOPP

In this part, the two methods of analysis SADT and OOPP used in this research are presented.

3.1 SADT Method

The SADT (Structured Analysis Design Technique), a very useful technique for describing and understanding complex systems, [9]. SADT uses a graphical approach to break down systems into manageable pieces so that relationships are immediately visible, functionalities are easily defined, and operations can be optimized. SADT can give us informative visions whether we are dealing with engineering systems, computer software development, or business processes for clear communication and active system design. SADT is a multi-purpose tool (Figure 2, Appendix) that can be applied to a large number of system types, [10]. The top-down approach of it enables us to start with a representation of the entire system as a whole and then look more deeply into the details of each of the subsystems, [11]. The orderly decomposition simplifies complex systems and makes them simpler to analyze and comprehend. SADT offers two major diagram types, [12]: Activity Model Diagrams (AMDs) that portray the system's functional activities and their interactions, and Data Model Diagrams (DMDs) that depict the system's data flows and transformations, [13]. SADT utilizes a specified set of symbols to draw its diagrams. The activity box is the most critical, meaning some certain function or activity in the system. Activity boxes are connected by arrows, which identify flows of various aspects, [14]. Data arrows are employed to express the flow of information used or produced by activities. Control arrows, by contrast, depict outside influences regulating the way activities are conducted. By understanding these symbols and how they relate to each other, we can effectively create good and useful SADT diagrams, [15]. Activity Model Diagrams (AMDs) are the foundation of SADT analysis. They visually represent the functional activities of a system and how they relate to one another, [16]. Each activity box in an AMD represents a specific function or process that the system carries out. Arrows connect these activity boxes, illustrating the flow of various elements influencing and resulting in each activity, [17]. Data arrows point to information flow, and control arrows point to external factors controlling how activities are carried out. Mechanisms, also marked by arrows, are the machinery or materials needed to carry out the activities. By creating AMDs, you can create a visual map of the operation of the system and how the components work together.

3.2 OOPP Method

OOPP is a term that means Objective-Oriented Project Planning. It is a systematic planning of a project with the focus on engaging all stakeholders, [18]. Unlike the traditional top-down planning process, OOPP engages everybody who is interested in the project, from the community members to government officials, [19]. The holistic approach ensures that the project plan is founded on an agreed understanding of the needs and priorities of the community, [20]. OOPP is a collaborative project planning process that involves all stakeholders who have a vested interest in any project to classify and examine issues, and then work together to develop a viable and concrete project plan, [21]. This is particularly the case in community settings where there are many groups who have a vested interest in the successful completion of the project. By opening channels of communication and dialogue, OOPP contribution facilitated that there is an understanding among the stakeholders concerning the purpose, problems, and solutions of the project (Figure 3), [22].

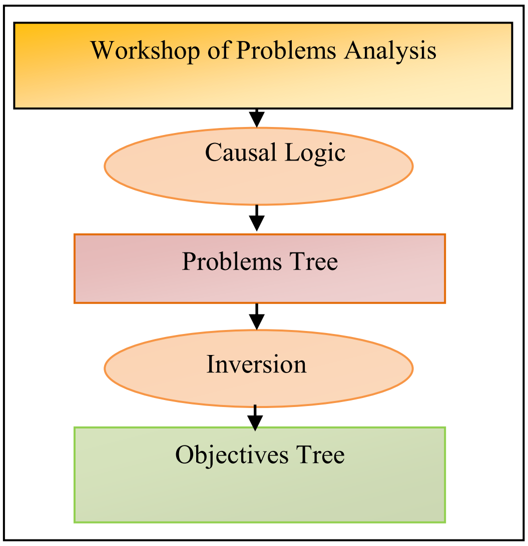

Fig. 3: OOPP analysis

There are numerous benefits of using the application of OOPP methodology, [23]. To begin with, OOPP can be used in the aim of obtaining stakeholders' buy-in since it involves all the stakeholders in the planning process. The stakeholders will be likely to accept the project if they feel that their issues were considered and addressed when necessary. Secondly, OOPP will assist in improving the project's design because it is easy to spot problems and issues prior to them growing into serious problems. With the involvement of stakeholders in planning, OOPP will ensure that the project will be tailored to suit the needs of the community, [24]. Third, OOPP can ensure improved resource allocation by helping to identify the resources needed to complete the project, [25]. By involving the stakeholders at the planning stage, OOPP can help ensure that the resources are well utilized and used efficiently, [26]. Fourth, OOPP can enable improved stakeholder communication and coordination, [27]. Since OOPP brings together the stakeholders to discuss the project, it can help build trust and relationships. Fifth, OOPP can boost project sustainability through ensuring that the project is intended to meet the long-term needs of the society, [28]. With stakeholder involvement in planning, OOPP can be able to guarantee that the project will make a good difference in the lives of the people for generations.

4 System Analysis of Packer Machine of Cigarettes

After a presentation of the two methods used in this research, we will analyze the numerous subsystems and components of the packer machine of cigarette (Figure 4) based on the analysis of the SADT (Structured Analysis Design Technique).

The cigarette packaging line has four machines: the packer which ensures the entrance of cigarettes, packs it in 20 and wraps them to get packages; the over wrapper which allows to wrap packages with cellophane paper; the cartridge use which allows to group two packets in 10 interposed, and wrap them in cellophane paper to get a carton of 10 packs. The carton allows grouping 50 cartridges, and packing in a carton (Figure 5).

Fig. 4: Packer machine of cigarette

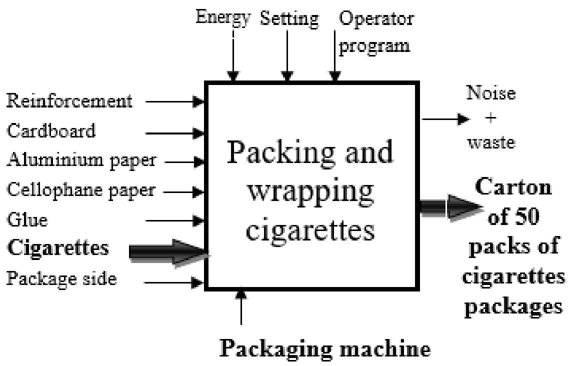

Fig. 5: Node A-0 of SADT model of packer machine

5 Proposal of a Model of the Information System

We present in this part an OOPP model that delineates eight specific objectives designed to achieve the overarching goal (OG) of establishing an Information System (IS) for the manufacturing process of cigarettes. This breakdown of specific objectives into outcomes (Table 1, Appendix) leads to the identification of intermediate outcomes, activities, sub-activities, tasks, and subtasks. By meticulously delineating these components, the model provides a comprehensive roadmap for the development and implementation of the information system, ensuring clarity and effectiveness throughout the process.

6 Conclusion

In this paper, we realized an SADT and an OOPP study on the packer cigarettes line to develop the manufacturing process. This is why we began our study by decomposing the packer cigarettes line on the basis of the SADT method to accomplish a functional analysis to classify the constituents of every engine.

By adopting a systematic approach, we aim to enhance transparency, efficiency, and accountability within the grain grading process. This systematic method will facilitate the identification of key components, interactions, and dependencies, thereby enabling informed decision-making and effective resource allocation.

Using the OOPP method for this analysis allows us to define the information system, which in turn aids in the creation of management and project management tools. Consequently, the development of data processing resources will be made more accessible.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

The authors wrote, reviewed and edited the content as needed and they have not utilised artificial intelligence (AI) tools. The authors take full responsibility for the content of the publication.

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Contribution of Individual Authors to the Creation of a Scientific Article

- F. Khanchel prepared, created formulated general aims and objectives of the research, and presented the published work.
- M. N. Lakhoua, has supervisory and leadership responsibility for the planning and execution of research activities. In addition, he prepared, created, and published the work, in particular the writing of the initial draft.

Sources of Funding for Research Presented in a Scientific Article or Scientific Article Itself

No funding was received for conducting this study.

Conflict of Interest

The authors have no conflicts of interest to declare.

APPENDIX

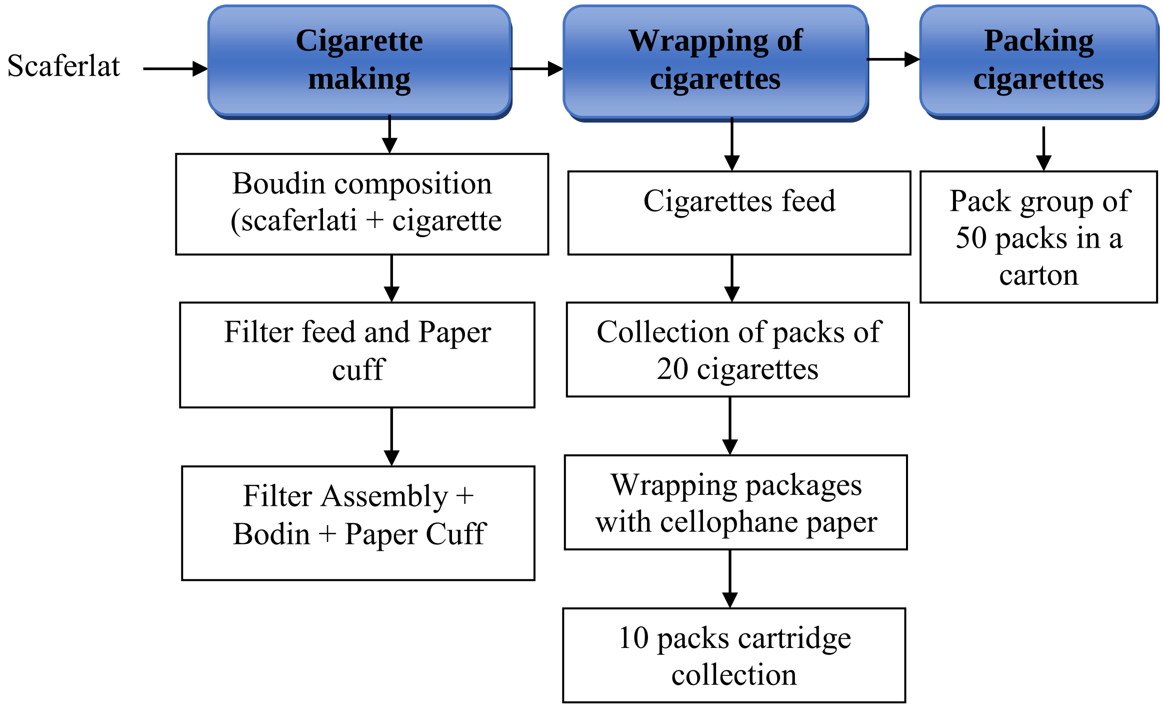

Fig. 1: Cigarette manufacturing process

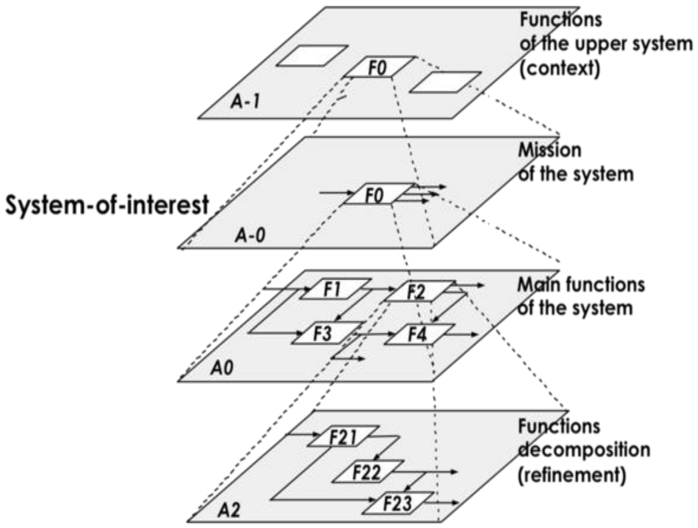

Fig. 2: Structure of an SADT model

Table 1. OOPP model of the IS of a manufacturing process

N°	Code	Activity
1	OG	IS of a manufacturing process
2	OS1	Guarantee of IS management certain
3	R1.1	Improvement of IS certain
4	R1.2	Assessment of the IS certain
5	R1.3	Control of the IS certain
6	R1.4	Sustainment of the IS certain
7	R1.5	Operation of the IS certain
8	OS2	Safety of the IS certain
9	R2.1	Safety of the information certain
10	R2.2	Guaranteeing the confidentiality of the information certain
11	OS3	Assurance of information circulation certain
12	R3.1	Guaranteed implementation of a secure information flow circuit
13	R3.2	Assurance of timely information availability
14	OS4	Assurance of suitable information media
15	R4.1	Functioning of information media ensured
16	R4.2	Ease of use of supports certain
17	R4.3	Accessibility of supports certain
18	R4.4	Supports of the information certain
19	OS5	Analysis of effective information certain
20	R5.1	Proposed actions for improvement suggested
21	R5.2	Identified causes of failure examined
22	R5.3	Failures have been detected
23	R5.4	Interpreted and processed information
24	OS6	Efficient processing of information certain
25	R6.1	Efficiency of the information processing system certain
26	R6.2	Information documented
27	R6.3	Information accumulated
28	OS7	Information archived
29	R7.1	Security of archived information certain
30	R7.2	Locations of archival information identified
31	R7.3	The supports of archival information are identified
32	R7.4	Period of archival information determined
33	R7.5	Archival information identified
34	OS8	Characterization of the information certain
35	R8.1	Identification of information needs complete
36	R8.2	Definition of information sources established
37	R8.3	Destinations for the information specified