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Workflow System Design for Manufacturing Industries

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Abstract :- **To deal with the ever-rising global competition, the quest to reduce cost of doing business and the rapid development of new services and products; companies must constantly reconsider and optimize the way they do business and change their systems and applications to support the evolving business processes. This research provides solution for workflow which entails presenting the processes involved in the processing/manufacturing of rubber products in a rubber manufacturing industry. The paper adopts the activity-based methodology to perfectly capture the processes (as well as tasks) from delivery of raw materials, through the stages of rubber production, up to the stage.**

INTRODUCTION

Diimitrios et al. (1995) posited that Workflow is an intuitive and powerful paradigm for capturing business processes, reasoning about them, and using process specifications to produce corresponding implementations that are supported by the information systems. Workflow is a term used to describe the tasks, procedural steps, organizations or people involved, required input and output information, and tools needed for each step in a business process. A workflow consists of a sequence of connected steps where each step follows without delay or gap and ends just before the subsequent step may begin. It is a depiction of a sequence of operations, declared as work of an organization of staff, or one or more simple or complex mechanisms. The workflow in manufacturing companies revolves around processing and sharing of information contained in business documents as well as technical copy documents. The process is composed of interdependent stages, from design and editing to storage and distribution. It is a specific challenge in maintaining productivity, cost-efficiency, and security in every stage. Workflows are increasingly used in life and sciences as a means to capture, share, and publish the steps of a computational analysis. (Kristina H. et al.) Workflow is fundamentally about the organization of work. It is a set of activities that coordinate people and/or software. Communicating this organization to humans and automated processes is the value-add that workflow provides to our solutions. Workflows are fractal. This means a workflow may consist of other workflows (each of which may consist of aggregated services). The workflow model encourages reuse and agility, leading to more flexible business processes. It may be seen as any abstraction of real work. For control purposes, workflow may be a view of real work in a chosen aspect, thus serving as a virtual representation of actual work. The flow being described may refer to a document or product that is being transferred from one step to another. Workflows may be viewed as one primitive building block to be combined with other parts of an organization's structure such as information silos, teams, projects, policies and hierarchies. The concept of workflow is closely related to several fields in operations research and other areas that study the nature of work, either quantitatively or qualitatively, such as artificial intelligence (in particular, the sub-discipline of AI planning) and ethnography. The term *workflow* is more commonly used in particular industries, such as printing and professional domains, where it may have particular specialized meanings. Firstly it can be called Processes; A process is a more specific notion than workflow and can apply to physical or biological processes, for instance. In the context of concepts surrounding work, a process may be distinguished from a workflow by the fact that it has well-defined inputs, outputs and purposes, while the notion of workflow may apply more generally to any systematic pattern of activity (such as all processes occurring in a machine shop). Second it can be called Planning and scheduling: A plan is a description of the logically necessary, partially ordered set of activities required to accomplish a specific goal given certain starting conditions. A plan, when augmented with a schedule and resource allocation calculations, completely defines a particular *instance* of systematic processing in pursuit of a goal. A workflow may be viewed as an (often optimal or near-optimal) realization of the mechanisms required to execute the same plan repeatedly. Thirdly, it can be referred to as Flow control**;** Flow control is a control concept applied to workflows, to distinguish from static control of buffers of material or orders, to mean a more dynamic control of flow speed and flow volumes in motion and in process. Such orientation to dynamic aspects is the basic foundation to prepare for more advanced job shop controls, such as just-in-time or just-in-sequence. Lastly is In-transit visibility, which refers to the monitoring concept that applies to transported material as well as to work in process or work in progress, i.e., workflows. Historically rubber products including tires were manufactured from natural rubber although the use of synthetic rubber began in the 1930s. Data from the United Kingdom census of production show that in 1930 that there were 520 natural rubber works. In 1968 there were 548 establishments manufacturing natural rubber and 310 manufacturing

synthetic resins, plastic materials and synthetic rubber. In 1993 the corresponding figures were 660 and 599 respectively. The use of carbon black as filler was adopted at the turn of the century. This would cover the manufacture of products from natural and synthetic rubbers including tires, foot wears, belts, hoses and numerous miscellaneous products and components. Rubber products also include latex products such as latex foams, carpet backing, condoms and gloves. Note that Latex is a stable dispersion or emulsion of minute particles of rubber dispersed in aqueous medium. Rubber processing/manufacturing involves raw materials which include natural and synthetic rubbers (hydro-based polymers), inorganic and organic compounding ingredients or additives are the main products delivered to the manufacturing sites or the rubber processing works. Specifically, other raw materials needed include reinforcing filler (to improve tensile strength, abrasion and tear resistance in the final product), vulcanizing or curing agents, processing aids, plasticisers and extenders (to soften rubber in order to facilitate mixing process). Others include anti-degradants, activators, acceralators, stain protectors, solvents, retarders (used to avoid premature vulcanization).additives are also used in the manufacturing process and they include Miscellaneous additives which include: Waxes – to protect the rubber beneath from ozone attack, Tackifying resins – posses adhesive properties and make rubber sticky when processing, Peptisers- used as promoters for the mastication of some natural rubber, to make it easier to mix, and to promote dispersion of additives and Hardeners, desicants, colouring pigments and flame retardants. The manufacturing process involves a wide range of production technologies and rubber formulations but the type used depends on the nature of the end product. Two main types of processing (dry and wet) exist but for the purpose of this presentation we would limit it to dry processing. The workflow design would focus on dry processing which has stages that include Preparation, Mixing, Shaping and fabrication, Vulcanization and Finishing. Note that workflow design would include processes involved in delivering the above-mentioned raw materials to the warehouse.

BACKGROUND STUDIES

The concept of workflow is not new. Workflow technologies first emerged in the mid-1970s with simple office automation prototypes at Xerox Parc and the University of Pennsylvania's Wharton School of Business. Interest in workflow and office automation began to wane in the early 1990s until the book *Reengineering the Corporation* reignited interest in workflow and business processes. The reengineering trend of the 1990s gave us several books and methodologies for process analysis – unfortunately the technologies such as CASE and their ilk were immature and required significant manual intervention, exposing projects and executive stakeholders to significant levels of risk. Even worse, other "workflow products" were thinly disguised efforts to sell hardware such as scanners, printers, and other peripherals. Clearly the term "workflow" was being abused to take advantage of confusion in the market. The modern history of workflows can be traced to Frederick Taylor and H. Gantt. Rudolf Laban and Warren Lamb contributed to this in England. Together, Taylor and Gantt launched the study of the deliberate, rational organization of work in the context of manufacturing. The types of workflow of concern to Taylor and his contemporaries primarily involved mass and energy flows. These were studied and improved using time and motion studies. While the assembly line remains the most famous example of a workflow from this era, the early thinking around work was far more sophisticated than is commonly understood. The notion of *flow* was more than a sequential breakdown of processing. The common conceptual models of modern operations research, including flow shops, job shops and queuing systems, can be found in early forms in early 20th century industry. Information-based workflows began to grow during this era, although the concept of an *information* flow lacked flexibility. A particularly influential figure was Melvil Dewey (inventor of the eponymous Dewey Decimal System, who was also responsible for the development of the hanging file folder). This era is thus identified with the simplest notions of workflow optimization: throughput and resource utilization. The cultural impact of workflow optimization during this era can be understood through films such as Chaplin's classic *Modern Times.* These concepts did not stay confined to the shop floor. One magazine invited housewives to puzzle over the fastest way to toast three slices of bread on a one-side, two-slice grill.

METHODOLOGY

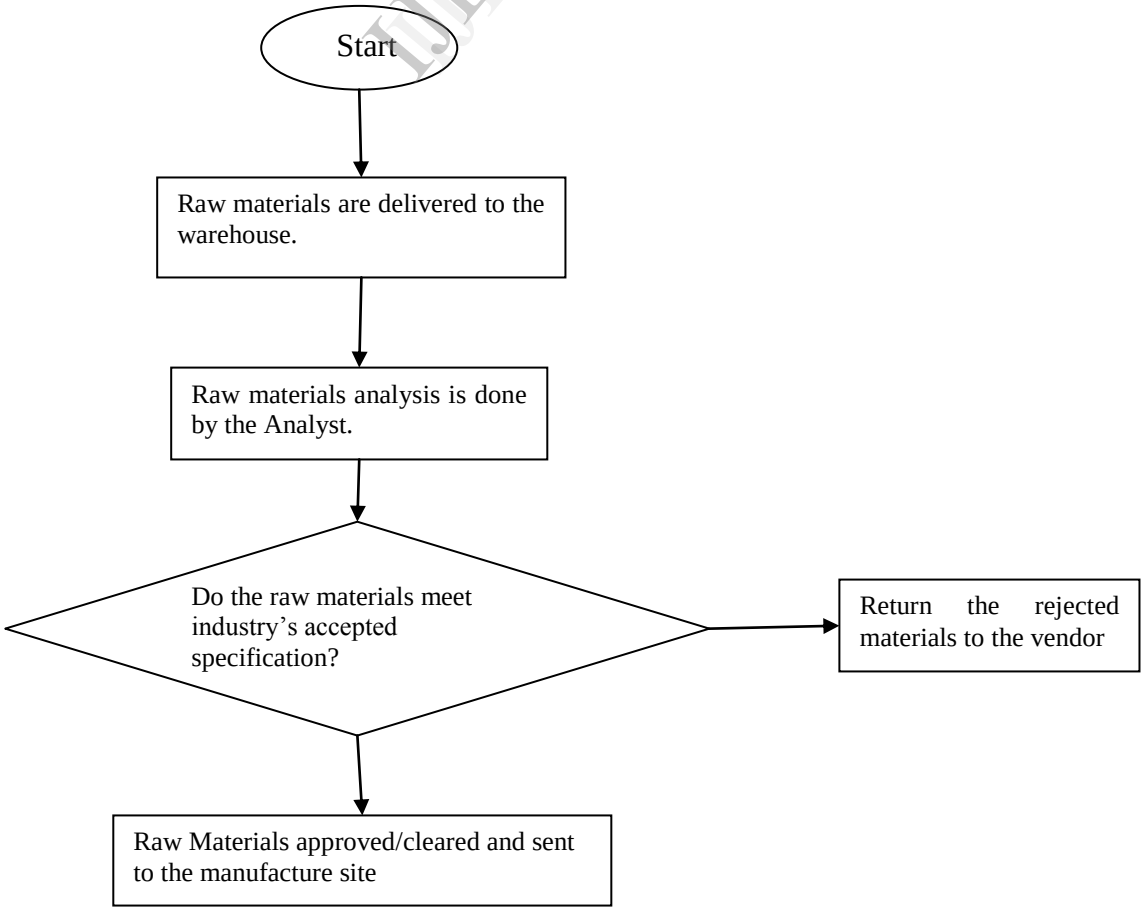
Process modeling involves capturing a process in a workflow specification. There are two basic categories of process modeling methodologies: *communication-based* and *activity-based* (Marshak 1994). Communication-Based Methodology stem from Winograd/Flores "Conversation for Action Model" (Winograd 1987). This methodology assumes that the objective of business process re-engineering is to improve customer satisfaction. It reduces every action in a workflow to four phases based on communication between a *customer* and a *performer*. 1. Preparation - a customer requests an action to be performed or a performer offers to do some action 2. Negotiation - both customer and performer agree on the action to be performed and define the terms of satisfaction. 3. Performance - the action is performed according to the terms established.4. Acceptance - the customer reports satisfaction (or dissatisfaction) with the action. Each *workflow loop* between a customer and performer can be joined with other workflow loops to complete a business process. The performer in one workflow loop can be a customer in another workflow loop. The resulting business process reveals the social network in which a group of people, filling various roles, fulfill a business process. Since this methodology assumes that the objective of business process re-engineering is to improve customer satisfaction, the emphasis is on the customer. However, there are business processes where the customer emphasis

may be superficial, e.g., if the objectives are to minimize information system cost or reduce waste of material in a process. Therefore, this methodology is not appropriate for modeling business processes with objectives other than customer satisfaction. Another limitation is that this methodology by itself does not support the development of workflow implementations for specifications. Activity-based methodology focus on modeling the work instead of modeling the commitments among humans. For example, consider the workflow where the process "procuring materials" for example, is composed of several tasks. Unlike communication-based methodologies, activity-based methodologies do not capture process objectives such as customer satisfaction. The communication-based and activity-based workflow models can be combined when process re-engineering objectives are compatible with both models (e.g., satisfy the customer by minimizing workflow tasks and human roles). Object-oriented methodologies, such as those proposed in (Rumbaugh et al. 1991) and (Jacobson 1992) may be useful in defining workflow specifications (and deriving implementations). For example, Jacobson describes how to (i) identify objects that correspond to "actors" (i.e., workflow roles), (ii) identify the dependencies between those objects, (iii) use object techniques such as inheritance to organize object specifications, and (iv) describe "use cases" which are essentially a sequence of tasks needed to complete some business process. Use cases may also include "alternative courses" which describe how to handle exceptional conditions. However, object orientation provides no explicit support (e.g., workflow model) for process modeling. The object designer typically must define workflow model-specific objects from scratch. This problem can be addressed if workflow-model-specific types and classes (e.g., customer, employee, document, computer system, workflow, step, etc.) are defined to support business process modeling directly. The activity-based methodology would be chosen for the representation of work processes in a rubber manufacturing industry.

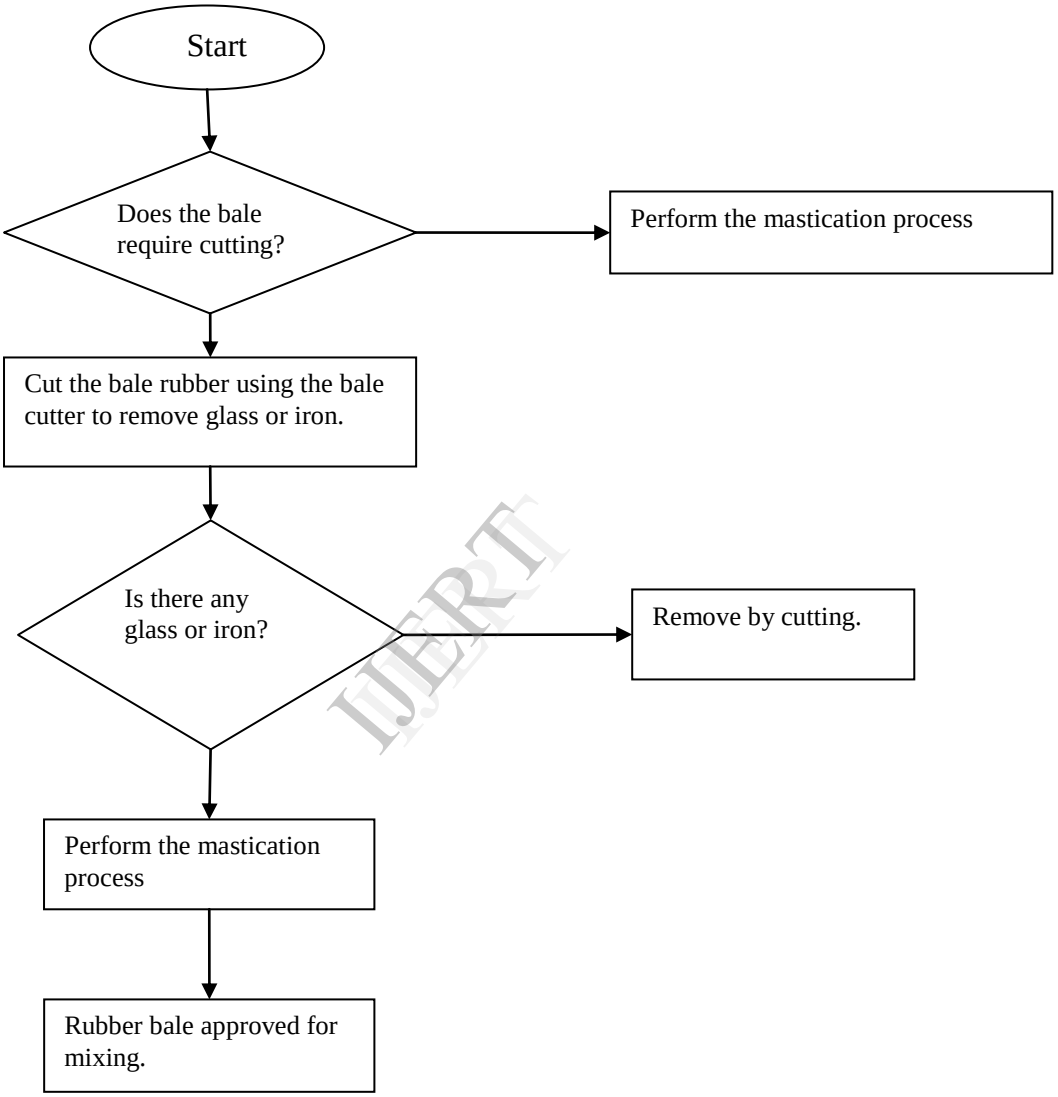
DESIGN

Using the activity-based methodology, the research presents the work processes in a rubber manufacturing company. Flowchart symbols where also used to present the progress from one task/activity to another. The flowchart symbols used include the start and end symbols, the processing symbol as well as the decision symbol e.t.c. The diagramming application availed the opportunity to use the flowchart symbols. The simple algorithm design for this research has supported the use of standard symbols for the flowchart. The algorithm stands for step by step instruction for the solution of the problem. The flowchart design projected the method for the solution of the problem using pictorial representations.

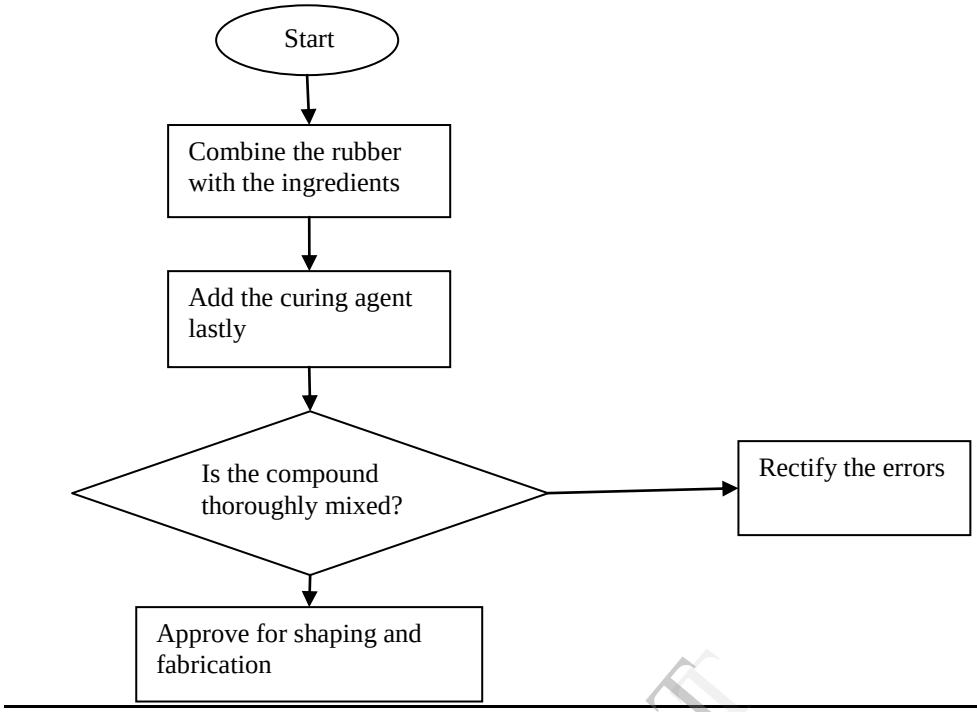
Workflow For Raw Material Delivery

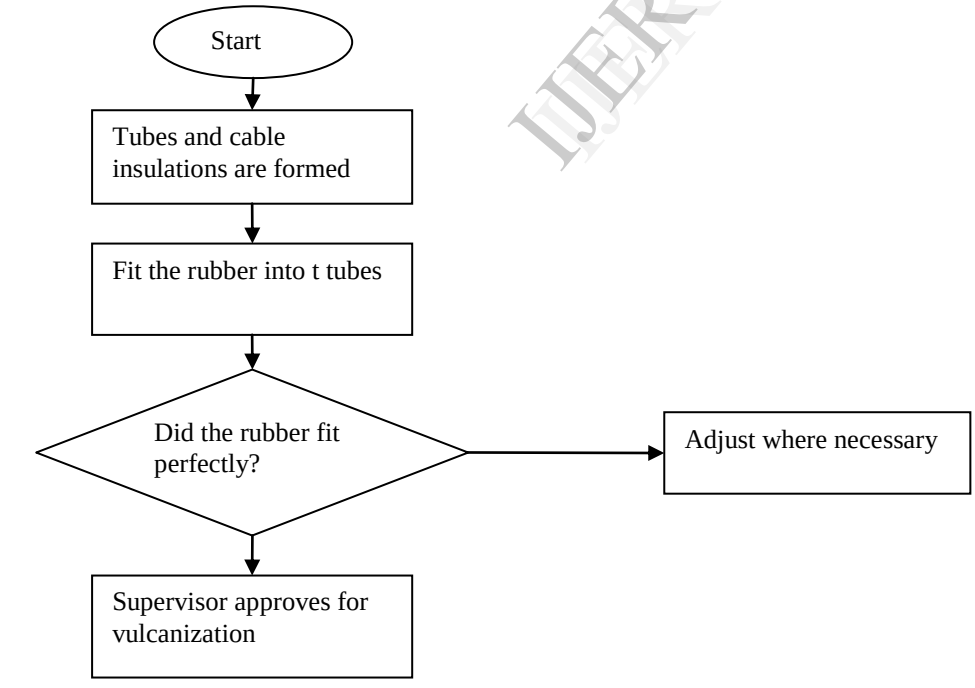


Industrial Process: Dry Processing
Preparation Stage Workflow

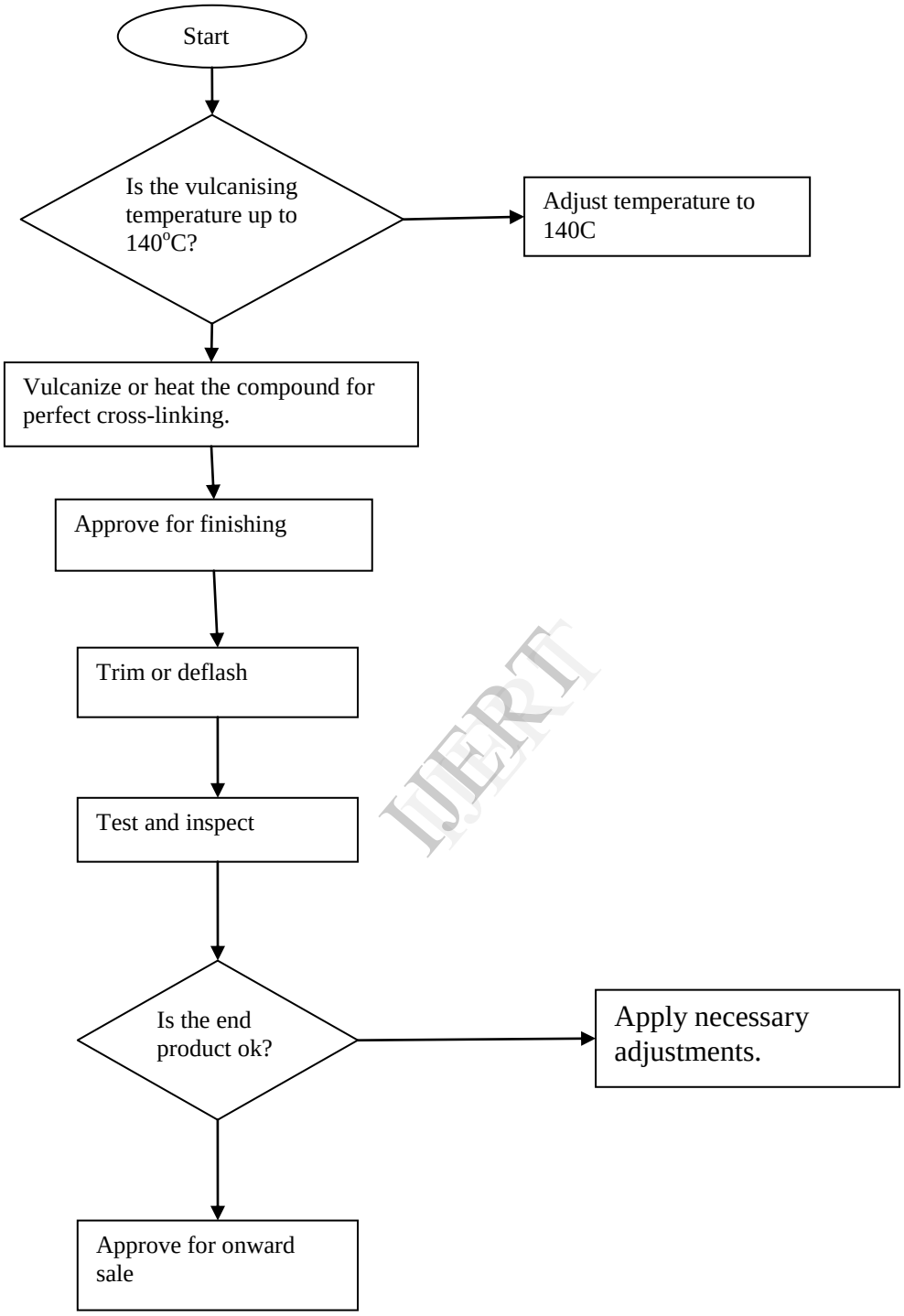


Mixing Stage Workflow





Vulcanization And Finishing Workflow



CONCLUSION

The system assists the management in creation, workflow, and storage of documents within different departments. A document management system stores documents in a database and associates important. New and modern technologies offer incredible potential: revenue growth, improved customer satisfaction, productivity, scalability and stronger brand image. However, these innovations can also make technology environments more complex. To reach its full potential, technology must be easy to use. The software ensures the critical technologies work like they should all the time for all the customers around. To respond to customer needs, manufacturers must reduce their time to market and time to volume. And to respond to demand and supply shifts, they must be able to adapt to changing situations. To meet these challenges, companies require integrated solutions ensuring that manufacturing runs at the pace of their business.

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