SIMULATION MODEL AND ANALYSIS OF AUTOMOBILES MANUFACTURING SYSTEM

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Abstract

The global financial crisis, brewing for a while, really started to show it sin automobiles Automotive manufacturing is complex and includes the coordination of design and manufacturing. In the manufacturing approaches over the past few years, assembly has been a key issue and it seems simulation models are usuallytailoredtoaddressanarrowsetofi ndustrialissues.Thispaperdescribesthe developmentofmanufacturingsystemd esign,operation,andmaintenancebased onSimulation.Themodelisbeingdevelo pedattwodifferentlevels:thesupply chain, the assembly plant. A solution that may optimize one performance measure may deteriorate otherperformancesolutiondifficult.The resultingalgorithmsarecomparabletot hesimulationintermsofsuccessrate,asse mblytimes,peakforcesandmoments,an dhaveassemblytimessuperiortothoseof abenchmarkblindsearchalgorithm.

Keywords: built-up assembly, Automotive assembly, Supply chain manufacturing, Simulation manufacturing, reproduction industry.

1. Introduction

Manufacturing simulation is one of the most powerful analysis tools available to those responsible for the designand operation of manufacturing systems and the model can be reconfigured for many situations in automotiveassembly(A.Dalvi;M.Guay.2009).Manufacturingapplicationincludebothfacilitydesign,aswellasenterprise-wide supply chain modeling. However, typical manufacturing model is usually used either to predict system performance or to compare two or more systems design or scenarios(ScottMiller.2000).

Inthemain,Genericsimulationidentifiescommonmodelinputandoutputdatainterfacesthatcouldbestandardizedforparticularmodelinglevelandsimulationcasestudies.Simulationstudyisessentiallyademandingand resource intensive task involving at least two major activities: Model building and experimentation (BennyTjahjono; RaúlFernández. 2008). In an increasingly competitive world, simulation has become a very powerfultool for the planning, design, and control of manufacturing systems to facilitate current andfuture training,experimentation,andtestingofinteroperabilityofsoftware(PoornachandraRao,ViraChankong.2005).Accordingly,manycompanieshad applied simulation to the decision making processes.

As pointed out by Pegden, because of fierce competition, industry is now being forced into implementing expensive factory automation and is, therefore, carefully reexamining it. Operating policies and procedures.Typical manufacturing competitive priorities or strategies are low cost, delivery,

flexibility and quality (Fritz J;DoloresH. Russ.1997).

Vehicles successively pass through three different shops (body, painting and assembly). Each of these shops hasspecific constraints and perturbations that locally modify the pre-defined sequence of vehicles(Jitesh Kapadia.1998). The assembly lines consist of a set of stations that produce one or many products. Each product must gothrough each station in the same order. In order for an assembly line to function properly, the operations in thestations must be balanced with respect to cycle time (MehrdadZoroufi. 2004). The analysis evaluated the coststructureforconventionalvehicleman ufacturingandretailingandassignedshares ofthemanufacturer'ssuggestedretailpricet ovariouscost contributors(DeogratiasKibira;CharlesR. McLean.2007).

This paper focus on development of Vehicle manufacturing system design, operation, and maintenance based onSimulation.Theprocessinvolvesanumb erofoperations,whichrequireassemblingt ogetheraccountsoffabricated and purchased components, subassemblies, and systems. In addition, the overall goal to virtualmanufacturingenvironmentprocess toprovideinteroperabilitytestssupporttoth emanufacturers,researchers,andstandards organizationswillbe achievebyusingARENAsoftwareforsimul ationmodelasshowninfigure1.

Fig.(1)The product stage Using ARENA Software

The sequence of the work presented hereare:

- Identify facilities, systems, operations, parts, and processes in automotive manufacturing assembly to developthe model.
- Develop the simulation model of the final assembly plant.
- Performconformanceandacceptanc etestingusingsimulationstocreatethespeci fiedrangeofinputsforadeliveredsystemorp rocess.
- Evaluateeffectivenessofnewinterfac estandardsandprotocolstomeetmanufactu ringindustryneeds.

Finally, the expected result shows that the company could explore new operating procedures, organizationalstructures,etc.withoutdisru ptingongoingoperationsinadditiontocontr ollingthetimeintermofcompressedorexpa nded,allowingthespeedingor slowing down of product process inorder to achieve the target.

2. Theoreticalbackground

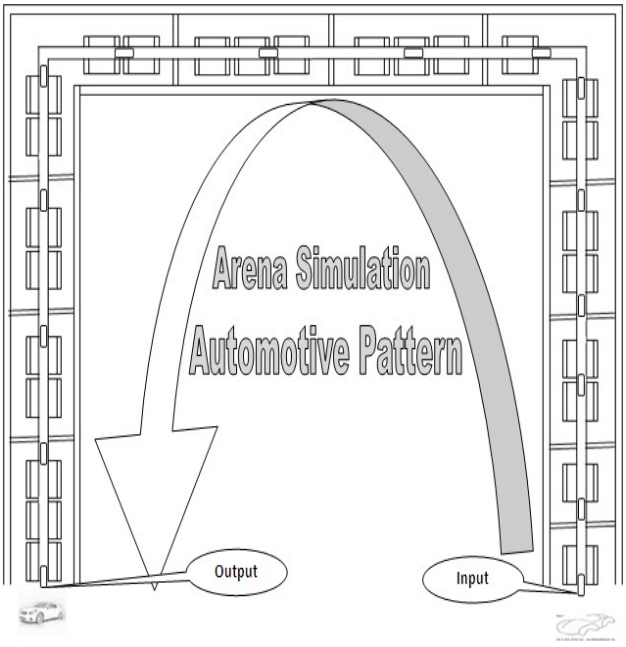
2.1 Manufacturing strategy

Manufacturing strategy has been defined as the pattern of decisions that, over time, enables a business unit to achieve a desired manufacturing structure, infrastructure andsetof specific capabilities.

Manyoldervehicleshadseparateunderlyin gstiffeningstructuresandbodiesforhousin gthepassengers.Therefore, the design requires more materials and results in a heavier car and contributes to raise the costs.Generally, the automotive production process consists of three major sections: the body shop, the paint shop, andthetrimassemblyshop.Inaddition,toot hersectionswhicharethepowertrainassem bly(consistingoftheengine,gearbox, clutch, and transmission), and the press shop if body parts are stamped at the plant. Also, there is a finaltesting process where vehicles are checked for water tightness and a stationary road test (Deogratias Kibira;CharlesR.McLean.2007).

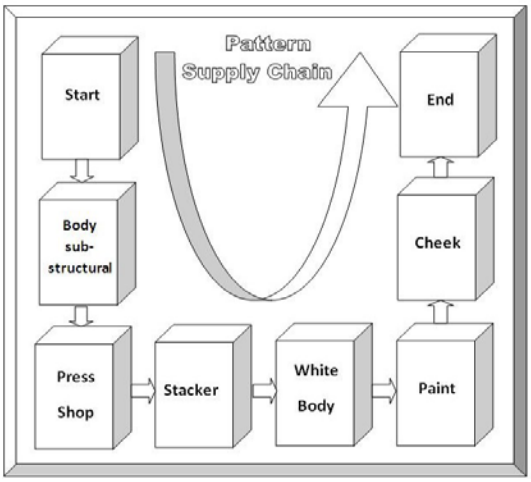
At assembly shop, some parts are usually assembled into the body before it is merged with the power system; theprocessiscalled“bodydrop”sinceitisthe bodythatisusuallyloweredontothechassis/ powersystem.Typically,themosttrimasse mblyoperationsarecarriedoutmanuallyan ditneedsaworkerortwooneithersideoftheli neatastation.Ontheotherhand,thereissuffi cientspaceonwhichtowork,equipmentand toolsspecifictothestationaswell as racks or bins on which the parts are stored for assembly.

An assembly line is a special case of the product layout. Adopting a product layout makes sense when the batchsizeofagivenproductorpartislargerela tivetothenumberofdifferentproductsorpart sproduced.Assembly



linesrefertoprogressiveassemblyoperatio nslinkedbysomematerialhandlingdevice. Virtuallyanyproductthathasmultipleparts andisproducedinlargevolumeisproducedo nassemblylinestosome degree(JiteshKapadia.1998).

Avarietyofconfigurationoptionscanbema debythecustomer.Theoptionsonthecarare thatitcanbeeithertwoor four door. A two-door car will require a different body side panel from a four-door car. Today most cars



aremanufacturedaccordingtothecustomer requirement(DeogratiasKibira;CharlesR. McLean.2007).

2.2 Simulation Model

Since the simulation is heavily based upon computer science, mathematics, probability theory and statistics: yetthe process of simulation modeling and experimentation remains very much an intuitive art. Simulation is a verygeneralandsomewhatill-definedsubject.Forthepurposeofthispaper ,wewilldefinesimulationas,"theprocessof designing a computerized model of a system (or process) and conducting experiments with this model for thepurposeeitherofunderstandingthebeha viorofthesystemand/orofevaluatingvario usstrategiesfortheoperationofthesystem." Thuswewillunderstandtheprocessofsimul ationtoincludeboththeconstructionofthem odelandtheanalyticaluseof themodelforstudyingaproblem.

Thesimulationrunsinacomputerworkstati onforitcostsalotofcomputingresources.Th esimulationprocessis:Firstly, design variables is assigned with initial values and then product analysis is executed with ARENA mode;secondly,designvariablesareextract edfromMatlabsoftware.

3. TheProposedMethod

Manufacturing simulation has been one of the primary application areas of simulation technology. It has beenwidely used to improve and validate the design

of a wide range of manufacturing system (Jonathan J.Shi. 2000).Hence,Computersimulationisapowerfultoolforanalyzingandoptimizingreal-worldsystemwithawiderangeof successful application (Michael W.Baenet. 2000). In this study, the computer simulation by using ARENAsoftwarewillbeusedtoimproveth eproductionlinethroughsupplychainand assemble.

3.1 Supply chains are large system consisting of many entities interacting in complex ways. The challenge facedbycompaniesishowtodesignandmanagesuchsystem(AngelisaElisabeth.2003). Thesimplepatternofsupplychainisshowsi n figure2.

3.2 Assembly of operations with production of parts. From a practical stand point of view it is preferred to have asystemdesignwhichhasamixofoperations andintegrationefficiencies,comparedtoade signwhichoutperformson normal criteria and completely to be distinguished by integration of assembly operations with production ofparts.Figure3showsthe simple pattern for assembly.

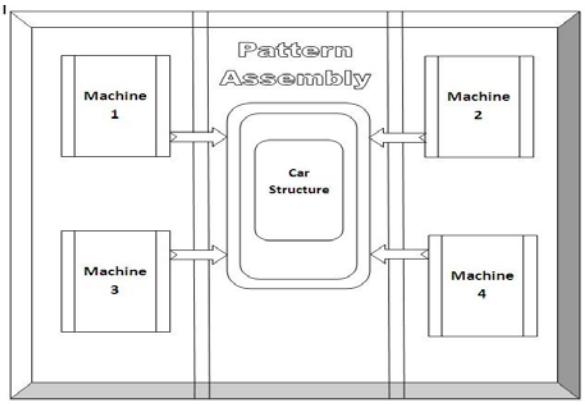


Fig.(3)PatternforAssembly

SimulationResult

The using of simulation model is to estimate objective function values when they are needed during the course ofoptimization, and uses a new rule for accepting a candidate solution that depends on the individual estimatedobjectivefunctionvalues.

The automotive manufacturing was applied according to the ARENA software design. The estimated operationtime was one month for 24 hours daily. In this month, 4518 cars will be produced as shown in table 1. The tablereviews al linformation about the software.Thus,simulation modelingcanbeconsideringasanexperimentalandappliedmethodologythatseeks to accomplish the use of model to predict tfuture behavior.

The model results are shown below to converge rapidly on an inventory management problem.Replicationendedat time: 714Hours

Simulationsruntime:2.37minutes

Identifier	Average	HalfWidth	Min	Max	Observations
Productiontime	4.56counters	Corr	4.52	4.56	4508
Identifier		Count	Limit		
NumberProduced	4472Infinite				

Table1.Resultapplicationtosimulationmodel

Toclarifytheresultsofapplyingthemodel,itcanbeobservefromthetablethedifferencebetweentheproductiontimeandtheamountofproducts,aswellasthedifferencebetweentheproductiontimesinthenormalcasewheretheproposedmodelisnotused.Thedifferentinproductiontimebeforeandafterusing AREAN Asoftwareisshowin figure4.

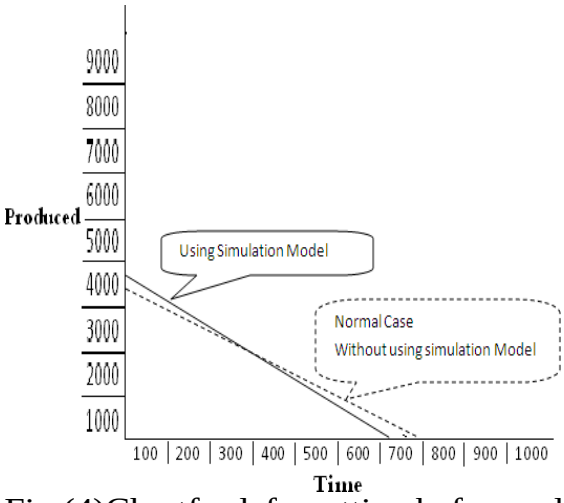


Fig.(4)Chartfordeferenttimebeforeandafterusingsimulationmodel

Conclusions:

Themodelhasbeenintegratedwiththesupplychainsimulationdevelopedinanothersystembyusing(ARENA).The main focus of this paper was to simulate a production facility that manufactured car based onsimulation model. The amount of products and the time saving showed the difference between before and afterusing simulation. The obtained data from the model can be applied to select the line produce to achieve optimumproduct. Finally, by introducing the model the company could explore new policies, operating procedures, and organization alstructureswithout disrupting ongoing operations.

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