IMPROVEMENTOFOILPANBYUSING VALUEENGINEERINGMETHODOLOGY

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ABSTRACT:

Valueengineeringisaproventoolforreducingcostsandincreasingthevalueoftheproducts.Thishasadirectbearingonimp rovedcompetitivepositioninthemarketplaceandincreasedprofitmargins.Thisprojectdescribestheimplementationofth istoolforanoilpandesigninICengine.ValueengineeringfortheOilpanaimsinreducingthecomplicatedmanufacturingby virtueoftheprocessandalsobyeffectiveutilizationofrawmaterial,whichdirectly resultsinreductionofmaterial &processcost.Thesimplifiedmanufacturingprocesswilleffectivelyimprovetheproductionratebyreducingthetimetake ntomanufacturetheproduct.Tofindthebest possible alternative from the choices we have incorporated a tool named as Decision Matrix. Decision Matrix gives the mostappropriate result and is even easy to use. The selected alternative method is modeled with Pro Engineer tool and is simulated inanalysistoollikeNASTRANtojustifytheachievedvibrationproperties.

Keywords: ValueEngineering(VE),OilPan,CostReduction

INTRODUCTION:

ValueEngineering(VE)isasystematicmethodtoimprove the "value" of goods or products and services by usingan examination of function. Value, as defined, is the ratio offunctiontocost.Value canthereforebeincreasedby eitherimprovingthefunctionorreducingthecost.

Value Engineering may be defined in other ways, aslongasthedefinitioncontainsthefollowingthreebasicprecepts: ValueEngineeringcycle

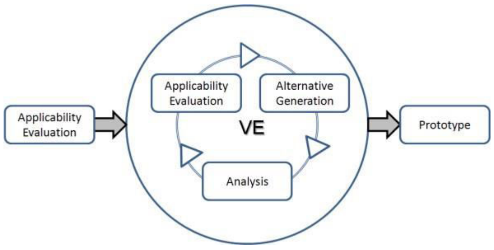


Figure1.

1. Anorganizedreviewtoimprovevaluebyusingmulti-disciplinedteamsofspecialistsknowingvariousaspectsoftheproblembeingstudied.

2. A function oriented approach to identify theessentialfunctionsofthesystem,product,orservicebeingstudied,andthecostassociatedwiththosefunctions.

3. Creativethinkingusingrecognizedtechniquestoexplore alternative ways of performing the functions at a lowercost,ortootherwiseimprovethedesign.

Value Engineering, which is originated from the USmilitaryindustryintheearly60ofthiscentury,hasbeenextensivelyappliedinconstructionindustrynowadays.Foo,T. H.(2002)andChong,S.N.(2002)hasgivensomeusefulframeworks on the application of VE. However, in India, VE ismostly associated to any alternative design with the intention ofcost cutting exercise for a project, which is merely one of theinitialintentionsoftheVE.ThispaperoutlinesthebasicframeworksofValueEngineeringandpresentsacasestudyshowing theimprovementofOilPan design in ICEngine.

II. ROADBLOCKSTOCOSTEFFECTIVENESS:

The practice of VEdoesn't imply thatthere may beintentional "gold plating," conscious neglect of responsibility, orunjustifiable error or oversight by the design team. VE simplyrecognizes that social, psychological, and economic conditionsexistthatmayinhibitgoodvalue.

The following are some of the more common reasonsforpoorvalue:

1. Lack of information, usually caused by a shortage oftime.Toomanydecisionsarebased on feelingsratherthan facts.

2. Wrongbeliefs,insensitivitytopublicneedsorunfortunateexperiencewithproductsorprocessesusedinunrelatedpriorapplications.

3. Habitualthinking,rigidapplicationofstandards,customs,andtraditionwithoutconsiderationofchangingfunction,technology,andvalue.

4. Riskofpersonalloss,theeaseandsafetyexperiencedinadherencetoestablishedproceduresandpolicy.

5. Reluctanceto seekadvice,failuretoadmitignoranceofcertainspecializedaspects ofprojectdevelopment.

6. Negativeattitudes,failuretorecognizecreativityorinnovativeness.

7. Overspecifying,costsincreaseasclosetolerancesand finerfinishesarespecified.Manyoftheseare unnecessary.

8. Poor human relations, lack of good communication,misunderstanding, jealousy, and normal friction between peopleare usually a source of unnecessary cost. In complex projects,requiring the talents of many people, costs may sometimes beduplicated and redundant functions may be provided.Cooperand Slagmulder, in their book, comprehensively discussed theinteractionbetweenthetargetcostingmethodandvalueengineering. They elaborately present the Survival Zone for aproductthatconsistsofthreecharacters:

1. Price,
2. Functionality,
3. Quality.

They discussed how these three factors interact witheach other and provide the Zone for the operations of the firm.ThisSurvivalZoneispresentedinFigure2.

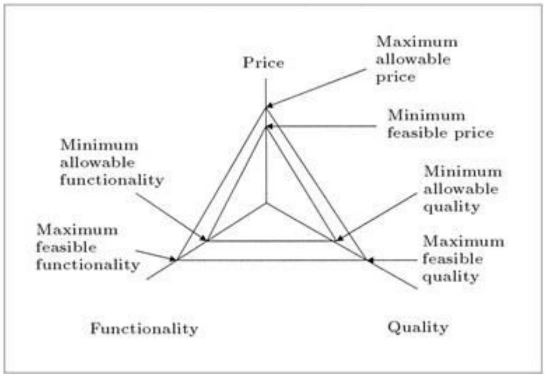


Figure2.Thesurvivalzoneforaproductsource

The interactionof price andfunctionality was,also,discussedbythem.Here,anattempthasbeenmadetoincorporate the third method (QFD) in this set. It is believed thata mathematical model is the proper tool for this incorporationand its feasible region precisely demonstrates the Survival Zone,whichwasdescribedin.

III. PHASESOFVALUEENGINEERING:

ValueengineeringisoftendoneinSevenPhases:

1. GeneralPhase
2. InformationPhase
3. FunctionPhase
4. CreativePhase
5. Evaluation Phase
6. InvestigationPhase
7. ImplementationPhase

1. GENERALPHASE:

DuringtheGeneralPhase,thestageissetbyorganizingthetaskforce,identifyingthedecisionmaker,selecting the areas of effort, assigning specifictasks to eachmember of the team and inspiring them for coordinated teamwork.VE work means problem solving forthe decision maker.It needs considerable personal contact, so use of good humanrelationwouldmeanthedifferencebetweenassistanceandresistance. The ground rules for the value effort are explained,laying emphasis on controlling opinions and feelings, as well asapplyinggoodbusiness judgments basedonfacts.

2. INFORMATIONPHASE

AftercreatingthecurvestheDrawingfileissavedin .dxf format. The same file opened and the Curves form the .dxffile copied and pasted in the sketch mode of CATIA for the allviews.

3. FUNCTIONPHASE

The function phase is key to the value effort. Here, theBASIC and SUPPORT FUNCTIONS are defined. The keystoneofvalueengineeringliesinstatingthefunctioninaTWOWORD, VERB NOUN combination, the former to indicate theaction the item performs and the latter, what is acted upon or theobject of the action. Work functions are always expressed inactive verbs and measurable nouns, which establish quantitativestatements; Sell functions,in passive verbs and non-measurablenouns, which establish qualitative statements. It sounds simple;butitisnoteasytoaccomplish.Costsaredetermined.

4. CREATIVREPHASE

In the Creation Phase, creative ideation techniques areusedtogenerateamultitudeofideas,products,processes,methods, etc., to accomplish the defined function(s). It involvestwo mental processes; the creative and the judicial. Suppressingthejudicial,aquantityofideasprovidingforthedefinedfunctions is generated. Refining, evaluation, etc., come in thenextphase.

5. EVALUATIONPHASE

In the Evaluation Phase, the judicial mind is broughtinto active use. The quantities of ideas generated in the creationphase are now appraised, modified,refined and combined togeneratethechangeproposal.Functionsalternativesaredeveloped compared and estimated for costs. The best ideas areselected.

6. INVESTIGATIONPHASE

The creative ideas so refined, evaluated and comparedarethensubjecttoinvestigationintheinvestigationphase.Vendorconsultations,assistanceofcompanyandind ustrialspecialties, use of company standards, industrial and nationalstandards,thatareapplicable,leadtothemostreasonable,practical, low cost high value solutions, without impairing theuseandesteemfactors,quality,safety,reliability,durability,etc.

7. IMPLEMENTATIONPHASE

Inthe**ImplementationPhase**,thevaluechangealternativeofmerit,selected,ispresentedasaVALUEENGINEERING CHANGE PLAN (VECP) to the management,forfinalapprovalandimplementation.Justastheworkstartedwithfacts,itisconcludedwithfacts,whichwill speakforthemselves. VECPs would be concise, show before and aftercomparisons, costs, advantages, disadvantages (if any), how toovercome them, plan for implementation (authority, cost, andtime frame for it), as well as acknowledgement of assistancereceived from others. It would contain sufficient data for thedecision-maker to determine the course of action to be taken aswellforpost-implementationaudit.

IV FLOWDIAGRAMOFVALUEENGINEERING:

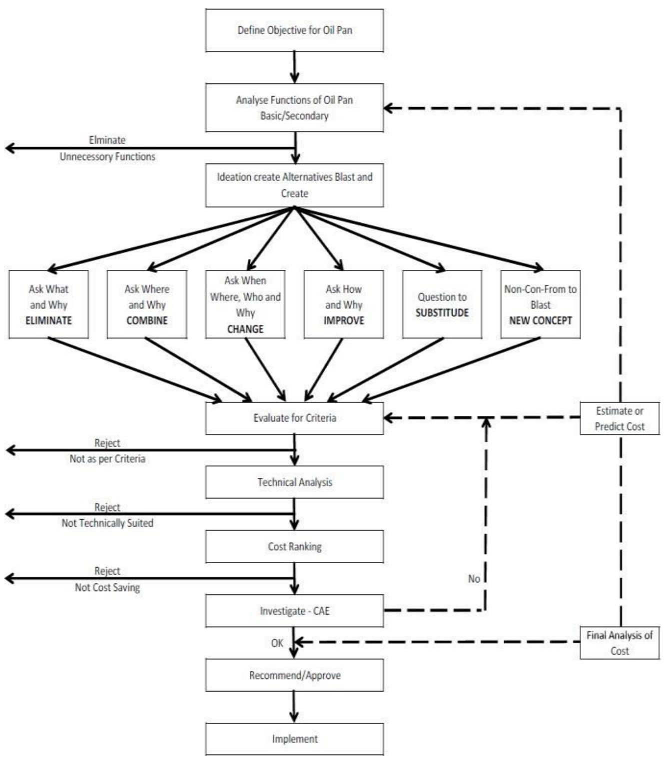


Figure3.FlowDiagramof ValueEngineering

V INTRODUCTIONOFOILPAN:

Oil pans (Refer Figure 4)are a major engine coolingsystem parts. They are usually constructed of Aluminum andshaped into a deeper section to fully perform its function. It isalso where the oil pump is placed. When an engine (refer figure5) is running or at rest, oil pans collects the oil as it flows downfrom the sides of the crankcase. In other words, oil pans that aremountedatthebottomofthecrankcaseservesasanoilreservoir. Engine oil is used for the lubrication, cooling, andcleaningofinternal combustionengines.

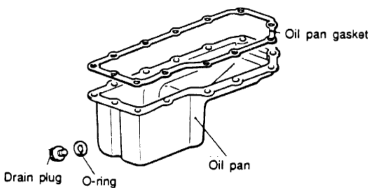


Figure4.OilPanLineDiagram

Generalphase

Thestageissetbyorganizingthetaskforce,identifying the decision makers, selecting the areas of effort,assigningthespecifictasks.

Thetasksare,

- ToreducethecostofOilPan.
- ToIncreasetheProductionrateofOilPan.

To achieve the above tasks, A work group was formed,composedofthreecostanalysts(Sheetmetal,Casting&Plastic

At the bottomof the pan is the oil drain plug that canbe usually removed to allow old oil to low out of the Engineduring an oil exchange. After the used oil drains out, the plug isscrewed back into the drain hole. Drain plugs are often madewith a magnet in it, collecting metal fragments from the oil.Some contains a replaceable washer to avoid leakage caused bycorrosionorwornthreadsinthedrainhole.

VI COOLINGSYSTEMOFENGINE:

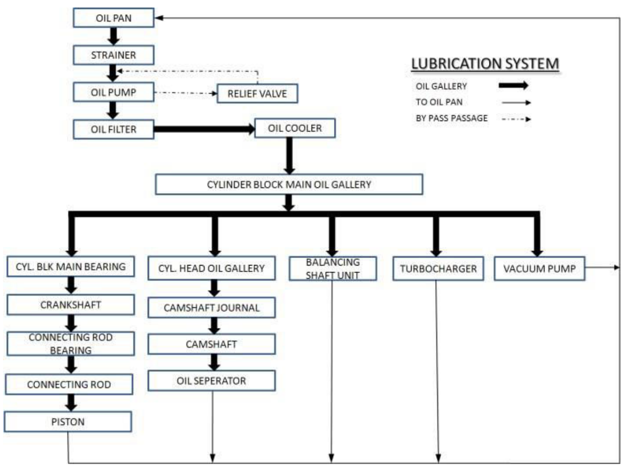


Figure6.CoolingsystemofEngin

VII PROJECT–VE:

At this stage of VE application, the six steps suggestedintheproposedmethodologywerecarriedout.
specialists) of theVE department, supported by people fromotherdepartmentssuchasEngineering,MarketingandManufacturing.
The group was led by CAE Team Leader and authorwas in charge of the coordination of the study, contact with thespecialists and suppliers, and the promotion of specific studiesaccordingtotheworkscheduleplan.

2. **Informationphase:**
As a primary source of information, specialists in thecompany, such as cost analysts, Casting specialists, as well astechnicaldocumentationaboutOilPanwereconsulted.
Presently Oil Pan (refer figure 7) was manufactured inAluminumCastingAlloy(LM4)withfollowingChemicalcomposition,

Copper	2.0-4.0%
Magnesium	0.15max.
Silicon	4.0-6.0%
Manganese	0.2-0.6
Nickel	0.3max
Zinc	0.5max
Lead	0.1max
Tin	0.1max
Titanium	0.2max
Iron	0.8max
Aluminium	Reminder

This manufacturing method involvs, Raw material cost,Process Cost,Machining Cost,Die Cost,Material Curing timeof casting and pan having volume of 6.2 Lit. and have otherfunctional requirements. Oil Pan having 18 mounting hols withdia.8.5mmforOilPan mounting with Cylinder Block.

Oil Pan having the provisionformagnetic drain plugforoildrainduringoilchanginginEngineandmagnetisprovidedforcollectingthemetalfragmentsintheOil.

IntheTesting,Leaktestshouldsatisfiedwith3bar
pressure.

OilPancostingsheetalsopreparedforAluminumCasting Alloy pan. The Cost of the Oil Pan is Rs. 857.59 as pernorms.Therequirementofquantityis20000peryear.

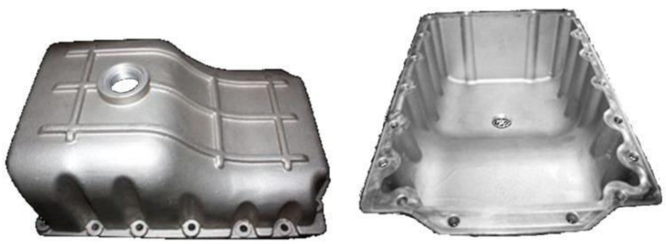


Figure7.AluminumAlloyOilPan

3. Functionphase:

In the Function Phase, each and every function if OilPan was analyzed. Those functions are categorized by PrimaryandSecondaryfunctions.
ThediagramoftheFunctionAnalysisSystemTechnique (FAST) was drawn to determine the interaction of thefunctions,supplyingasystemicvisionoftheproductunderanalysis,besidesfacilitatingthescopeofthestudy.

Primaryfunctions:

1. Whenanengineisrunningoratrest,oilpanscollectstheoilasitflows downfromthesidesofthecrankcase.
2. AttachedDrain-Plugisusedforcollectingmetalfragments fromtheoil.
3. NoLeakageofoilwhile vehiclerunningorrest.

Secondary functions:

1. AestheticLook
2. Finishing Quality
3. Cost
4. EasytoManufacturing,Assemble&Serviceability

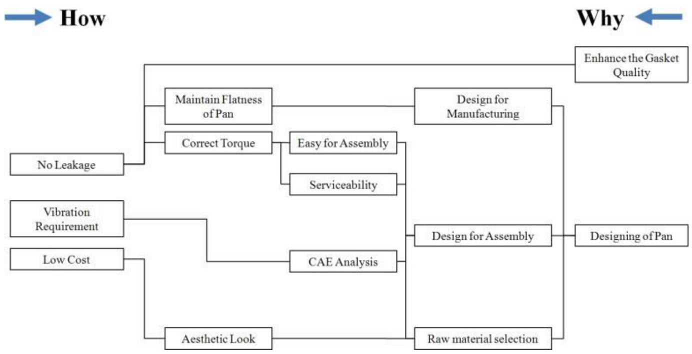


Figure8.FASTDiagramforOil Pan

4. Creativephase:

In the Creation Phase, creative ideation techniques areusedtogenerateamultitudeofideas,products,processes,methods,etc.,toaccomplishthedefinedfunction(s).

For Oil Pan improvement, the ideas are generated byteam which was having members from Maintenance, VehicleService,Marketing, PurchaseandDesign.

GeneratedIdeasare,

a. Oil PancanbemanufacturedinPlastic
b. MaterialChange -LowcostAluminum
c. DecreasetheCapacityofOilPan
d. Can decreasetheThicknessofOilpan
e. Can be develop the Transferent Oil Pan (PC orAcrylic)
f. SheetmetalOilpanwillreducethecost
g. ChangingtheSupplierforcost reduction
h. CombinationofAluminumwithSheetmetaloilpan
i. Requestthesupplierforcostreduction
j. IncreasetheAnnualVolumeofProductforCostReduction
k. Benchmarkwith otherproducts

5. Evaluationphase:

Inthisphasequantitiesofideasgeneratedarenowappraised,modified,refinedandcombinedtogeneratethechangeproposal.

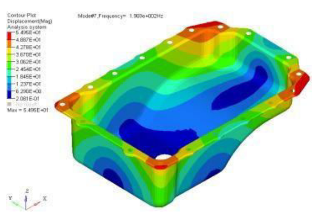
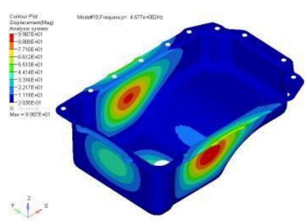
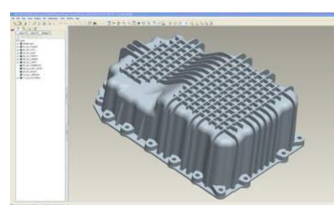
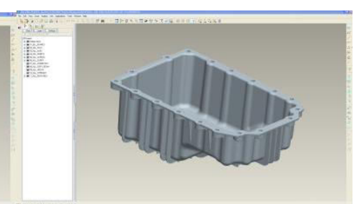
To find the best possible alternative from the choiceswe have incorporated a tool named as Decision Matrix (ReferFigure 9). Decision Matrix gives the most appropriate result andis eveneasytouse.

Decision Matrix												
	IDEAS	Manufacturability	Easy of Assembly	Serviceability	Machininability	Noise & Vibration	Possibility of Leakage	Tool Cost High-> 1 Low-> 10	Product Cost High-> 1 Low-> 10	Appearance	Rating	Remarks
1	Oil Pan can be manufactured in Plastic	8	8	5	-	7	7	3	6	7	6.375	
2	Material Change - Low cost Aluminum	5	8	6	6	7	7	5	3	6	5.8889	
3	Can decrease the Thickness of Oil pan	5	7	6	6	7	7	5	3	6	5.7778	
4	Can be develop the Transferent Oil Pan (PC or Acrylic Material)	3	6	6	-	7	6	1	5	9	5.375	
5	Sheet metal Oil pan will reduce the cost	8	8	7	-	4	6	3	8	7	6.375	
6	Combination of Aluminum with Sheet metal oil pan	6	4	7	4	5	5	1	3	6	4.5556	
7	Changing the Supplier for cost reduction										0	Tool Cost to be Invested
8	Decrease the Capacity of Oil Pan										0	Not Accepted
9	Request the supplier for cost reduction										0	
10	Increase the Annual Volume of Product for Cost Reduction										0	Not Accepted
11	Bench mark with other products										0	
	1 - Poor	3 - Satisfy				7 - Good		10 - Very Good				

Figure9.Decisionmatrixforideasselection

Based on the above decision matrix, we finalized thebesttwooptionsforfurtherstudy.

Option1
OilPanmaterialchangedtoSheetmetalinsteadofAluminumAlloy.Manufacturingmethodalsochangedtopressingforsheetmetalmaterial.toolwhichisusedformeshingandCAEanalysisareHypermesh.
MeshedmodelisanalyzedinNastran softwareasmodalanalysisforcheckingthenaturalfrequencylevels.

option2: DesignedPlasticOilPanbasedontheavailableplasticpandesigninthemarket.

Option2
OilPanmaterialandProcesschangedtoPlastic materialandPlasticmolding.

6. **Investigationphase:**

We go through the existing available sheet metal panandPlasticOilPanintheautomobileindustry.Detailedmethodologywasdevelopedbybasedonthestudyanddiscussionwith Sheetmetalpressingandmolding expert.

Option1:WedevelopedtheSheetmetal3DCADmodel for further analysis. Pro Engineer software (Refer Figure10) is used to modeling and generate 2D drawing. The model isfurtherinvestigated withNASTRAN software fortesting thevibrationcharacteristicsofpart.

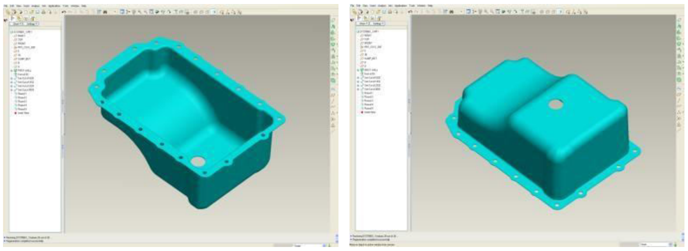


Figure10.3DmodelinProEngineer

CreatedOilPanmodelissavedin.igesformat.this.igesfilecontainingthegeometry istheinputfortheCAE

6. CONCLUSIONANDFURTHER WORK:

- ✓ Based on the analysis, developed sheet metalpan is not meeting the required frequency inthe modal analysis. need to be strengthenedandanalyzedagain.
- ✓ Developed Plastic Oil Pan also want to meshandanalysistoValidatethevibrationrequirements.
- ✓ Final decision will be taken by based on CAEresultsandcostoftheOilPan.

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