Design of Computer Aided Process Planning System for Holster Mold at PT. Carnegie Universal Industries

IOP Conf. Series: Materials Science and Engineering **528** (2019) 012061 doi:10.1088/1757-899X/528/1/012061

Design of Computer Aided Process Planning System for Holster Mold at PT. Carnegie Universal Industries

Amal Witonohadi[1], Nanang Ali Sutisna[2] and Martulan Suryanto Naibaho[3]

Department Industrial Engineering, Trisakti University
[1]amal@trisakti.ac.id [2]snanang@yahoo.com, [3]martulanmsn@gmail.com

Abstract. PT. Carnegie Universal Industries manufactures holster products and magazine carrier. Holsters have the most variants and the highest demand. To produce a holster, a mold is needed for each type of handgun. A mold uses wooden mold and blue gun. Mold making takes the longest time compared to other stages in the holster production process. The mold making process does not yet have standards, therefore it takes a long time and high cost. The purpose of this study is to develop a process planning to facilitate the making of molds with automated systems using the Computer Aided Process Planning (CAPP) method, speed up production time, and reduce production costs. The CAPP generative approach is generated through decision logic, formulation, search, algorithm and geometric based data. Database programs are created to store detailed information on each print that has been created. This approach design proved that the mold making procedures are simplified and speeded up and have standards, so that the time and costs are used more effectively and efficiently.
Keywords: CAPP (Computer Aided Process Planning), Holster Mold, Geometrics Database, Generative method.

1. Introduction

PT. Carnegie Universal Industries have 2 brand namely Pax Militari for weapon accessories and Pax Dynamic for gear equipment. Pax militari consisting of two the kind of product that produced the holster and magazine carrier with some variants that uses a material of KYDEX®, Holstex® and Boltaron®. The material of KYDEX® for holster has highest customer demand. A type of product a holsters containing KYDEX® material produced by several phase in the process of production. The phase that done in making molds, heating raw materials, forming, cooling, cutting, the assembling of, and finishing. The phase that was done among manufacture of mold, warming up, forming, cooling, cutting, assembling, and finishing. Now, mold used are a mold manual with timber and blue gun which have developed in accordance with the desired pattern.

A manual pattern from blue gun and timber set formed to the process of making mold phases. Making manual mold need around 2 hours, due to complexity and the number of cavity that is covered. Making patterns in process of a holster conducted twice, because a holster needs a side front and back of a weapon to load details. Holsters with manual mold used two sheets of KYDEX® material and have a mistake while cavity covered and improper pattern will result in defect of product. A defect which a manual mold is holster not conforming so that gun loose and details weapons are not formed.

The use of a manual mold have a really effect on the effectiveness and efficiency of the production. Time for used pattern is relatively longer and the use of two pieces of KYDEX® material considered wasteful because of KYDEX® material thrown out when cutting process. Holster that produced by PT. Carnegie Universal Industries maximum 4th product a day. This process is really had an influence on the quality and the speed of holster production PT. Carnegie Universal Industries. The company wanted increases the quantity and quality of production manual mold.

2. Problem Case

At the moment blue gun mold is made manually and takes long time and high cost, so that the efficiency is low. This study aims to improve the manual production of mold by automation system using Computer Aided Design (CAD), Computer Aided Process Planning (CAPP), and Computer Aided Manufacturing (CAM). The goal is to produce a better and more flexible planning system. The product focus of the study is the holster XD-9M.

2.1. Process Engineering

The planning process is a function in setting in the manufacturing process and determined process or parameters which are used to change early part to the end one, which was preceded by mechanical drawing [1]. The planning process of constituting the determination of the process of assembling and the manufacture and the ranking of in which this process should be completed to finish the product until the final form [4]. The steps of the planning process covering; (1) interpretation picture design, (2) the process and the order (3) the selection of equipment (4) the selection of tools, dies, mold, and gages, (4) the method of analysis, (5) Standard, and (6) Cutting tools and cutting condition

2.2. Process Planning

The planning process also called manufacturing planning, material process, process engineering, dan machine routing. Process engineering consisting of the process machinery and parameters used to convert early form part into the end of part based on mechanical drawing. The whole process needed preparation to declare an order to producing part and how to realize product design [2] Figure 1.

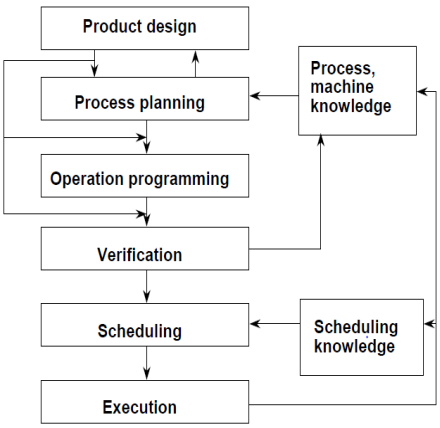

Figure 1. Production Flow Chat (Chang, 1998)

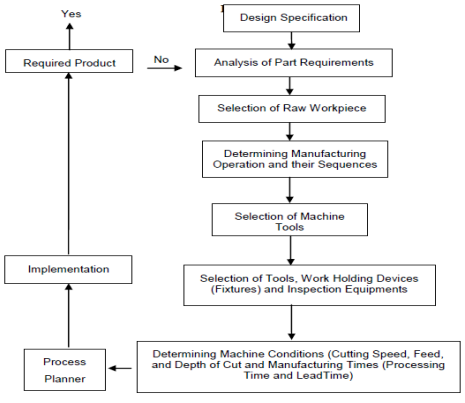

Figure 2. Process Planning Flow chat (IGNOU, 2017)

Process planning in manufacturing production is the phase that use to product design and processed to be product. Process planning of using the engine selection parameters, the selection of tools, scheduling and control the production as a Figure 2. A part of process planning [2] consisting of: Route, Processes, Process Parameters, Machine and Tool Selections, Fixtures. The form of process

planning used namely operation planning table that containing operation description, tools, machine, process parameter, machinery time, cost etc. Detail of process planning is presented in Figure 3.

2.3. Computer-Aided Process Planning (CAPP)

Process planning defined as a function in a series of manufacturing activity which it was decided that production process and the parameters further used to transform a material from originally into a shape in accordance with the desirable design [2]. Process planning of constituting liaison between the design and production. Process planning should be optimal, in which production based on this process, the last part should be can produced at the right time and lower cost of production. All will lead to the need for a computer based system that can function planning this process or can be called Computer-Aided Process Planning (Figure 4)

PROCESS PLAN — ACE Inc.

Part No. S0125-F — Material: steel 4340Si
Part Name: Housing
Original: S.D. Smart Date: 1/1/89 — Changes: _____ Date: _____
Checked: C.S. Good Date: 2/1/89 — Approved: T.C. Chang Date: 2/14/89

No.	Operation Description	Workstation	Setup	Tool	Time (Min)
10	Mill bottom surface1	MILL01	see attach#1 for illustration	Face mill 6 teeth/4" dia	3 setup 5 machining
20	Mill top surface	MILL01	see attach#1	Face mill 6 teeth/4" dia	2 setup 6 machining
30	Drill 4 holes	DRL02	set on surface1	twist drill 1/2" dia 2" long	2 setup 3 machining

Figure 3. Process Plan (Chang, 1998)

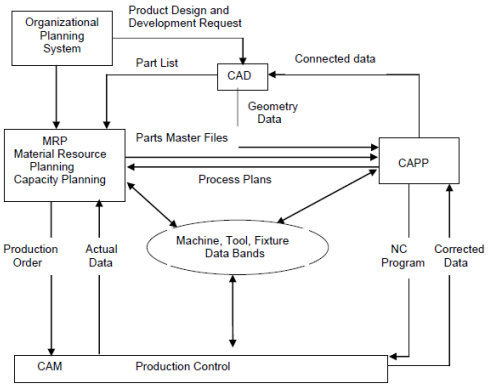

Figure 4. *Computer-Aided Process Planning* Flow chat (IGNOU, 2017)

a. Metode Varian

A method of variant than any manual with the methods, where new plan the process of parts arranged with identifying and looking for a plan that already exists in a database to part the same (is often called master part) categorized based the concept of group technology and make the modification which required to a new part. One of the weakness of a method of variant is the quality of the process plan are still highly dependent on planner the process. Computer is just be used as a device to help as manual processes planning activities. But, this method is still many be used, a number of reasons that form the basis of such as [3].

1. Hardware investment and small software. And there are many vendors to supports then the generative system.
2. Faster time to develop and unneeded many power. Installation easier than generative system
3. In a few instances, variant are more reliable system to be applied to the environment of production that is real, that to low class especially for corporations.
4. The quality of the plan process that is extremely dependent planner with knowledge and experience of the process

b. Method of Generative

A method the process of generative planning result through logic a decision, formulation, search algorithms, and data base of geometric designs. On the whole, the format of the input of a CAPP system can be divided into two categories all over the place, text input and graphic input. The text input is defined as interactive, and the graphic where data part is drawn in through cad module (is defined as the input interface) [3] .

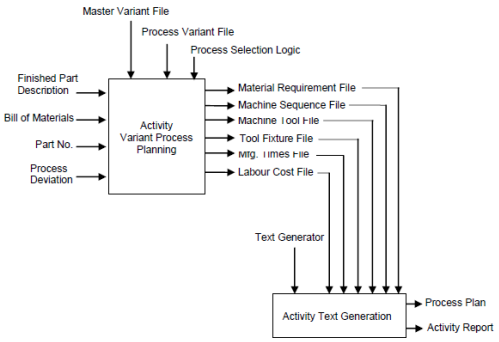

Figure 5. Varian of CAPP Flow chat (IGNOU, 2017)

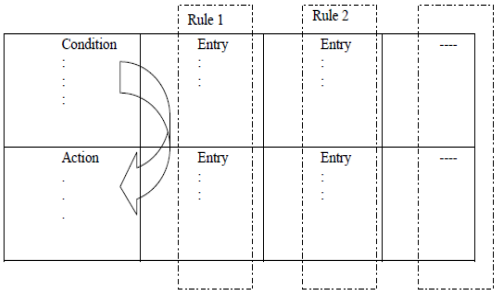

Figure 6. Generative of CAPP Flow chat (IGNOU, 2017)

Planning process with the methods generative do not used plan a standard for planning new components. This approach used manufacturing to produce a process planning. Its method try to imitate a planner the process who make plans the process of new part based on knowledge possessed [6]. In this method, plan a process not are kept on database, but database consisting of information on part, machine, tools and well as the rules process planning. Approach planning application process generative is a fit of a system based on knowledge [7].

c. Method of Semi – Generative

This method is approach while when there was the problem in system development planning process by using the method generative. A method of semi-generative can define as an application latest of technology variant by using type features generative. A system that uses a method of spring generative must be more being together with planner, where having knowledge technology. Responsibility planner is interpretation of data decision or image work.

3. Methods

A stage of methodology is;

1. Design Product by CAD
2. Coding design with fixture of product design
3. Part programme design made G-Code model with CAM tools
4. CAPP plan model
5. Result Operation Process Chat (OPC)
6. Compare production time between manual and automation of mold making.
7. Compare product cost between manual and automation of mold making.

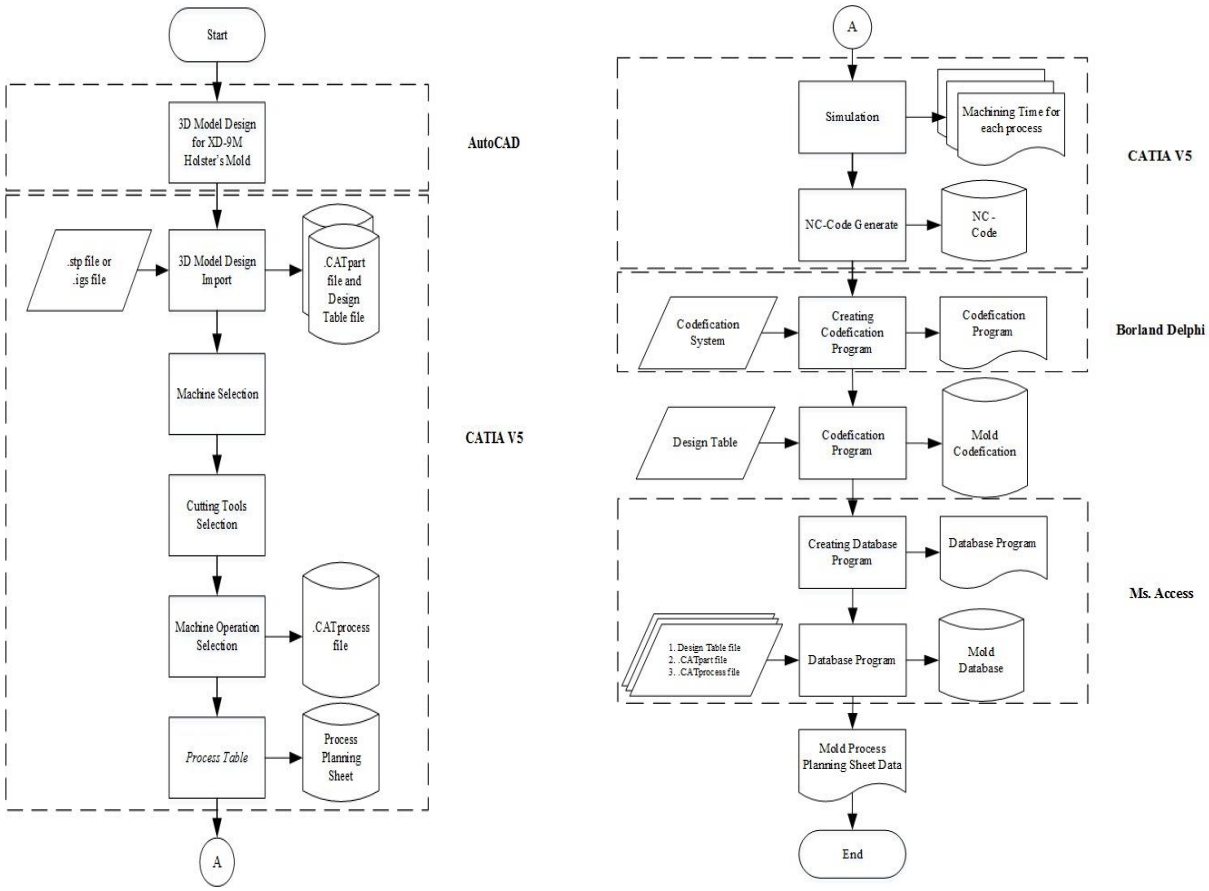

Figure 7. CAPP System Design Flow chat

4. Result and Discussion

4.1. Product Design

Figure 8. Holster Springfield XD-9M

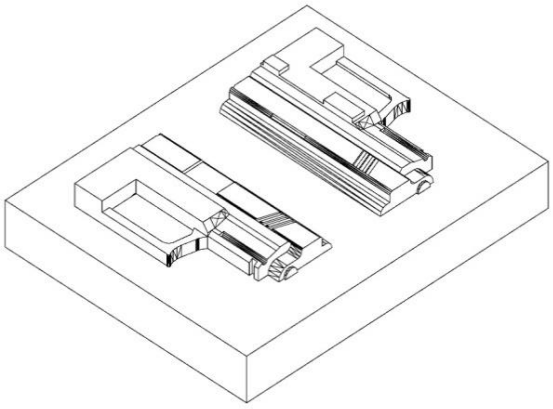

Figure 9. Holster Mold XD-9M

Activity	Value
Hole 1 Diameter (mm)	4
Hole 1 Hole Limit 1 Depth (mm)	36
Hole 1 Tap depth (mm)	10
Hole 2 Diameter (mm)	4
Hole 2 Hole Limit 2 Depth (mm)	36
Hole 2 Tap depth (mm)	10
Pad 1 First Limit Length (mm)	2.5
Pad 1 Second Limit Length (mm)	0
Pad 1 Thick Thin1 (mm)	1
Pad 1 Thick Thin2 (mm)	0
Pad 2 First Limit Length (mm)	2.5
Pad 2 Second Limit Length (mm)	0
Pad 2 Thick Thin1 (mm)	1
Pad 2 Thick Thin2 (mm)	0
Pocket 1 First Limit Depth (mm)	1.5
Pocket 1 Second Limit Depth (mm)	0
Pocket 1 Thick Thin1 (mm)	1
Pocket 1 Thick Thin2 (mm)	0
Pocket 2 First Limit Depth (mm)	1
Pocket 2 Second Limit Depth (mm)	0
Pocket 2 Thick Thin1 (mm)	1
Pocket 2 Thick Thin2 (mm)	0
Pocket 3 First Limit Depth (mm)	1
Pocket 3 Second Limit Depth (mm)	0
Pocket 3 Thick Thin1 (mm)	1
Pocket 3 Thick Thin2 (mm)	0
Shaft 1 Activity	true
Shaft 2 Activity	true

Figure 10. Design Mold Holster at Excel Format

4.2. Coding

A Step to design coding is access design table with format.xls than used parameter; pad, pocket, hole, shaft, chamfer, and fillet. Steps of coding process resulted table about operation information, coding for holster mold XD-9M. Then the final model of coding result is 0100000933011.

4.3. Part Programming (G-Code)

Holster XD-9M mold made by CNC machining process that the CNC Siemens and the Sinumerik840D to control system. Machining process arrange by CatiaV5 and G-Code program. The reason G-Code used is simple to purpose. The steps G-Code generation at CatiaV5 are process, relief, parameter used, simulation and generator of G-Code. For presentation a plan process needed a route sheet process. A route sheet collected number, name, material, tread machine, process, tools, and time each product.

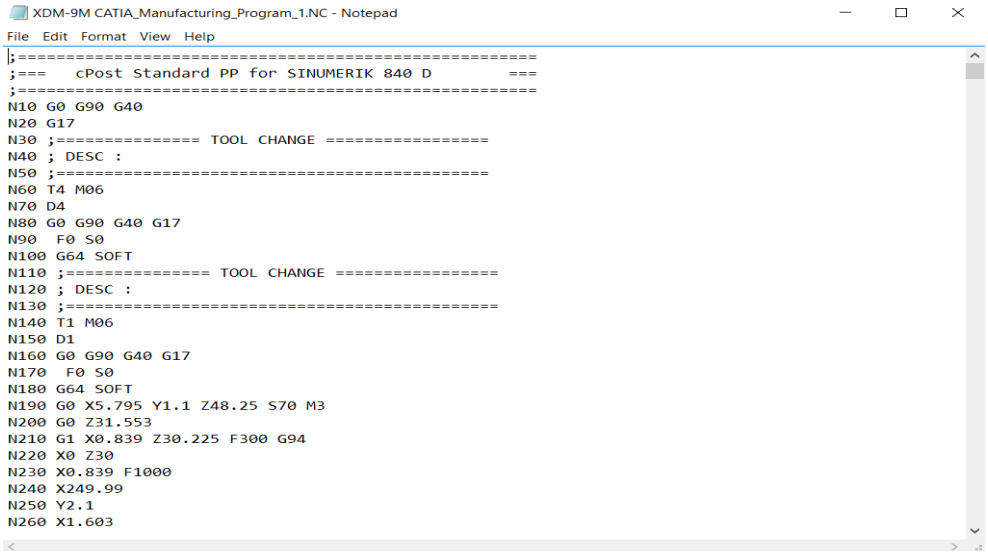

Figure 11. G-Code Programme Holster Mold XD-9M

4.4. CAPP Programs

Thera are two steps to plan CAPP program that the preparation with analysis of information system and generative CAPP program. The information system planned from customer needs until to final product. Steps of identification and analysis are PIECES Framework, Use Case Diagram, Data Flow Diagram, Entity Resources Diagram, and Physical Data Model. CAPP method with the generative has been implementation at the company that facilities are computer, HPE material, CNC Milling machine, Pressing machine, vacuum, oven etc.

Figure 12. Coding Programme Screen

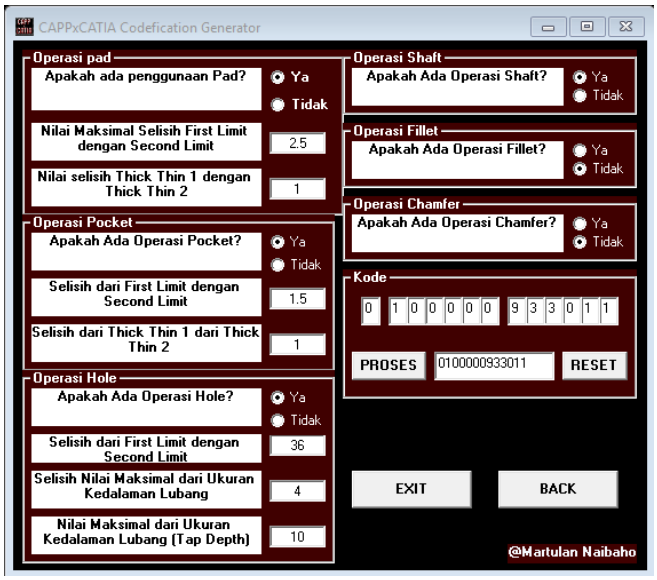

Figure 13. *Input* Data Screen

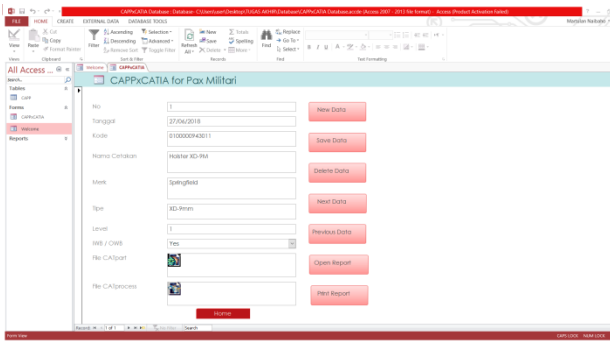

Figure 14. Screen of Input Data at Database Programme

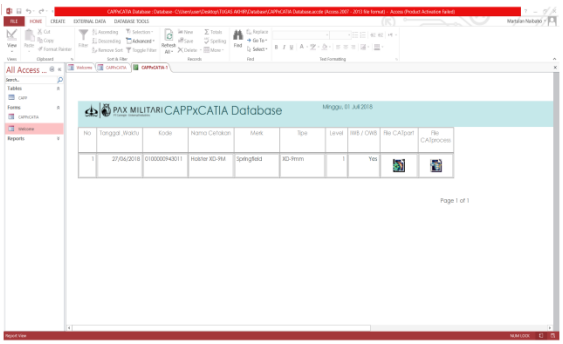

Figure 15. Screen of Database Programme Result

Result from implementation CAPP suggestion system at Table 1 and Table 2.

Table 1. Times Process Ratio Actual and Suggestion of Holster

Times Ratio Actual and Suggestion		
Operation Name	Actual (Minute)	Suggestion (Minute)
Mold Preparation	120	2
Melting and Casting Process	10	10
Setting and Rough Cutting	60	2
Finishing	60	1
Total	250	15

Table 2. Cost Ratio Holster Production

Cost Ratio Actual and Suggestion		
Operation Name	Actual	Suggestion
Material	Blue Gun	HPE
Description	Repetition Blue Gun yield mirror defect of mold could be product defect.	Used HPE hold up impact pressure and high temperature than restrain product defect
Cost	US $ 60 – 80	US $ 250-300
Capacity	1-3 product each of mold	10-30 product each of mold

5. Conclusion

1. The output produced by this study is a program code and database design parameter with Computer-Aided Process Planning (CAPP) system. The Database software systems were Borland Delphi and Microsoft Access.
2. The time to process a plan by CAPP decreases. With CAPP System the process to access the database is simple.
3. The time to produce a holster with HPE Mold using the standard process planning is increase from 262 minute to 169 minutes.
4. The time to produce a Holster Mold using CNC Milling Machine with G-Code programme is 125.2 minute. HPE mold by CNC Milling is the best choice to use. This is because it can be used repetitively, with lower risk defect compared to the blue gun mold method. The timing comparison between HPE and Blue Gun mold is 1:10.

6. References

[1] Chang, Tien-Chien. 1990 *Expert Process Planning for Manufacturing*. (United States of America: Addison Wisley Publishing Company)
[2] Chang, Tien-Chien., Wysk, Richard A., and Wang, Hsu-Pin. 1998 *Computer Aided Manufacturing.* Second Edition. (United States of America: Prentice Hall International)
[3] Gawlik, Edward. 2002 The Analysis of Methods for Computer Aided Process Planning. *Journal of Cracow* (Poland: University of Technology Cracow).
[4] Groover, Mikell P. 2008 *Automation Production Systems and Computer Aided Manufacturing*. Third Edition. Englewood Cliffs (New Jersey: Prentice Hall Inc.)
[5] Gu, P., and Norrie, DH. 1995 *Intelligent Manufacturing Planning* (United Kingdom: Chapman & Hall)
[6] Indira Gandhi National Open University. 2016 *Computer-Aided Process Planning*. IGNOU. India. Available: www.ignou.ac.in/upload/Unit-9-CRC.pdf [Accessed, August 7, 2018].