

NSRIC Inc. (Nature Science Research and Innovation Centre)

Ontario (ON), Canada Online Education (OE) Division



Basic Design and Pipe Drafting

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<https://www.nsrc.ca>

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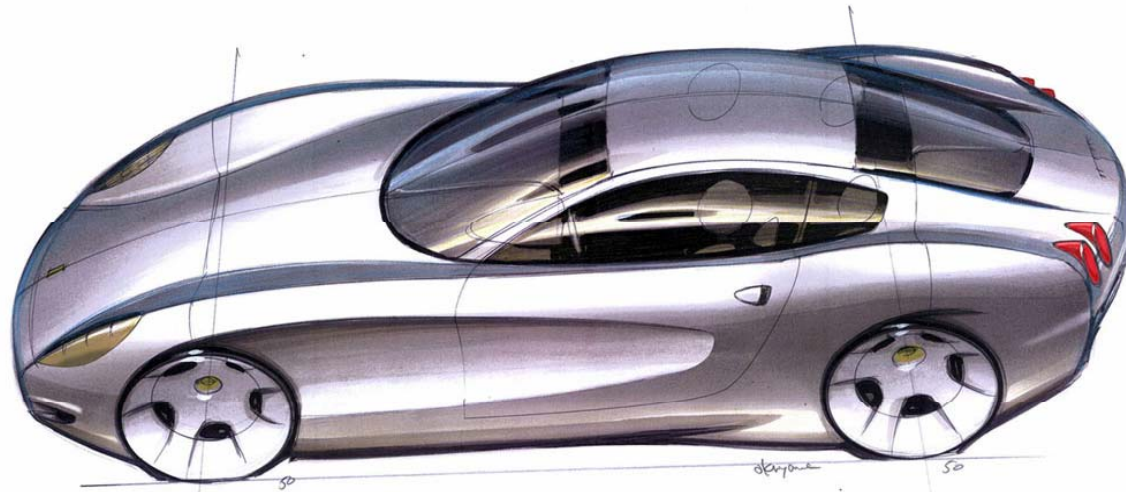
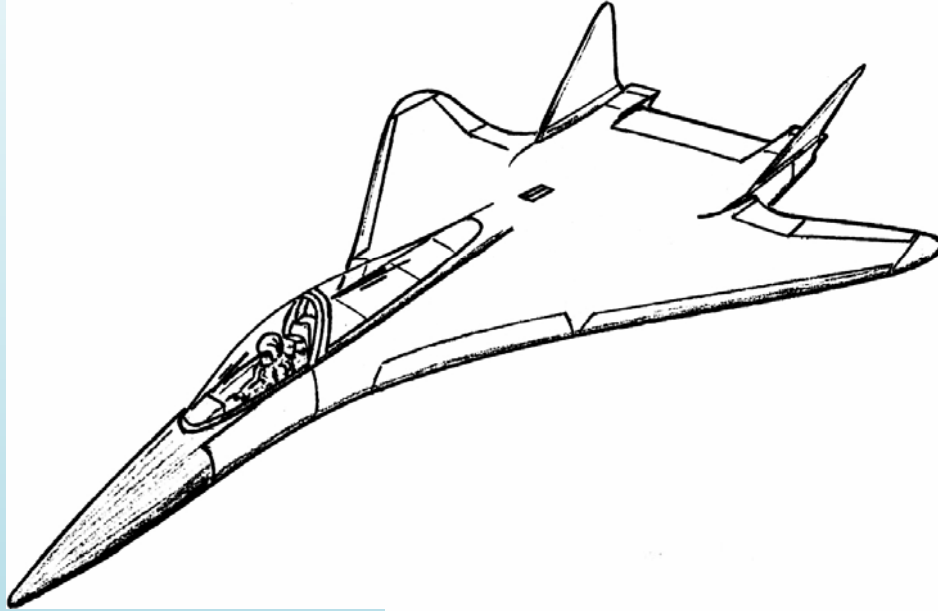


- 1) Introduction to design concept, engineering design process, how to do design, conceptual design, design cases, design software.
- 2) Introduction pipe drafting and design.
- 3) Steel pipe
- 4) Pipe flanges
- 5) Valves
- 6) Mechanical Equipment
- 7) Flow Diagrams and Instrumentation
- 8) Codes and Specifications
- 9) Isometrics

Lecture Times : Tuesdays EST 14-16 on class days

Tutorial Times: Sunday EST 14-15

Examples of Conceptual Design



Conceptual Design



Start with an *identified problem* or *opportunity*, i.e. Needs Assessment is performed and a **Product Design Specification (PDS)** is developed.

1. To develop different ideas and identify all the options to satisfy the **PDS**
2. To select the most promising alternative from all those ideas and options
3. To further develop this selected idea into a full concept design

Step 1 : Generation of Ideas and Options



- It is important to create **as many ideas** as possible, and identify a broad range of competing options.
- Inputs:
 - Design specification, client's problem statement, functions, objectives, constraints, etc. – i.e. the **PDS**
- **Methods and tools** that can be used:
 - Creative methods such as **brainstorming**
 - Data and information gathering and research, including the study of previous solutions, market (customer) studies and site visits
 - Your own notes and comments in your workbook made during needs assessment
 - **Other methods such as Morphological Analysis and Quality Function Deployment**, which are not covered in this introductory course



Brainstorming

- ❑ Brainstorming is the most widely used technique for a team to generate ideas and find solutions for a specific problem
- ❑ In brainstorming go through the phases below:
 1. **Brain dump phase.** A phase of rapid and abundant idea generation. - Make sure to write up everything that is said in your own workbook
 2. **Idea trigger phase.** Discuss each idea and take it as a starting point for further ideas. Again keep notes and record the results
 3. **Compilation phase.** Discuss, develop and discard. Compile final list of ideas which appear suitable for further development

Brainstorming in Conceptual Design



- **Brain Dump:**

- Start with your client's brief and your specification
- Get data and information on the design task
- Try to visualise what's required: express your task and write it down
- Look at the task from many different angles – write down your thoughts
- **Generate ideas** – write down, sketch and draw up each idea

- **Idea Triggering:**

- Discuss your sketches and your ideas in your team
- Extend and modify your sketches, draw up some more
- Ask yourself and your team mates questions about the task, your sketches and all the existing ideas
- Take a break and gather data and information

Concluding the Brainstorming Session



- **Compilation:**
 - Look at all ideas generated in the previous phase
 - Discuss them, and develop each to such a stage where you can judge whether it is feasible or not. Do this as a team exercise
 - Write and/or draw everything in your workbook as you go
 - Discard infeasible ideas (but don't erase them from your workbook)
 - **Compile final list of ideas which are suitable for further development**

Step 2 : Selection of the Best Design Option



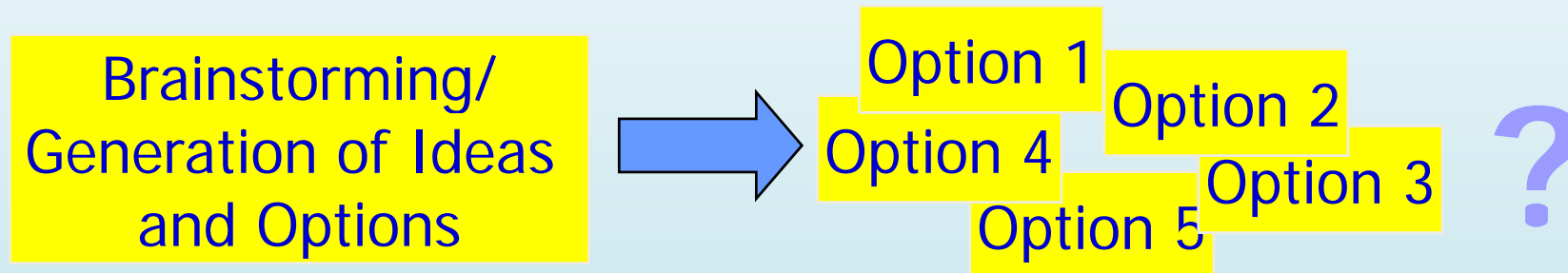
- Your ideas and design options have to be developed to a point where a rational decision can be made to select the best solution
- Making a choice among a range of good and potentially suitable ideas is generally quite difficult
- The selection of the ‘**best**’ design is critical.
- Some of these factors may also be subjective and depend on your value judgements, or on personal preferences
- Therefore it’s important that we use a **systematic approach** for making the selection



Evaluation for Final Concept Selection

- Infeasible and impracticable ideas and design options need to be **identified and eliminated** as early as possible
 - you don't want to waste your time with them
- After you've done this it is necessary to **select the most promising options** from the remaining ones.
- It is best to make your choices **on a rational and systematic basis**, and not by guesswork, rule of thumb, or intuition, for the following reasons:
 - Using an systematic approach adds credibility to the decision making process
 - It enables members of the design team and clients to participate in the process and assess the validity of the decision

Design Selection - a Multi-Parameter Problem



- The more **complex and open-ended** the design task, the more performance attributes and other factors will be involved in our decisions
- We must compare factors which often have **no easily defined** 'exchange rate'
- Factors which are '**soft**', such as ergonomics, safety, or aesthetic appeal, must be quantified somehow
- This type of decision-making is a **crucial** aspect of design, business, and management

Making Decisions in Multi-Parameter Problem Scenarios



- We have illustrated how complicated it can be to make multi-parameter decisions
- How are these sorts of decisions commonly made?
 - By using intuition, experience, inspiration, rules of thumb, etc. – this is often a good starting point for eliminating infeasible and unrealistic options
 - By discarding “soft” and difficult-to-define parameters, reducing the problem to a “manageable” level
 - By making economic comparisons (i.e. cost, price, etc.)
 - By using a a rational approach that takes all different decision criteria into account, such as
 - Plus/Minus/Interesting (PMI) etc.

Plus/Minus/Interesting (PMI)

PMI is a basic decision making tool. When you are facing a difficult decision, simply draw up a table headed up 'Plus', 'Minus', and 'Interesting'.

Plus	Minus	Interesting

- In the column underneath the 'Plus' heading, write down all the positive points of the particular option, considering in particular the specifications in your PDS.
- Underneath the 'Minus' heading write down all the negative effects.
- In the 'Interesting' column write down the extended implications of the option, whether positive or negative.

Source: <http://www.psychwww.com/mtsite/pmi.html>

Using and Scoring your PMI Table



- You may be able to make a decision just from the table .
- Alternatively, consider each of the points you have written down and assign a positive or negative score to each appropriately. The **scores** you assign can be entirely subjective
- Once you have done this, add up the score.
 - A strongly positive score indicates that the option should be accepted, a strongly negative score that it should be avoided.

CAD Design Software (Normally Licence)



Common: Microsoft Word 1983; Microsoft Visio 2000; Paintshop 1990; Photoshop 1990; Google Sketchup 2000
[pipe google sketch up.mp4](#)

Professional: AUTOCAD 1982 ; Pro/ENGINEER in 1988; Solid Works in 1995; ANSYS 2002

(not free software, find a student or older version)

Specialist : PROCAD; GIS; Geoseries Point ...

[**http://en.wikipedia.org/wiki/Pipeline_\(software\)**](http://en.wikipedia.org/wiki/Pipeline_(software))

Piping Design Software



ACPlant Designer - CAD/CAE tool for **piping design**

AVEVA - software for design **management, plant** engineering (Vantage reviews)

Bentley Plant Design Software - **2D/3D plant design** engineering software: OpenPlant (MicroStation), AutoPLANT (AutoCAD) and more software for full plant asset **lifecycle** management

CADPIPE - AutoCAD-based tool for **commercial/process piping**, HVAC, electrical industries, by Orange Technologies Inc.

DevPipe - product of research project of **analytical method making templates** between cylinders, conical, tubular truss, works with AutoCAD or IntelliCAD Discount CAD software at CADdepot

Intergraph - **Plant Design System** software includes SmartPlant P&ID, eMARIAN, FrameWorks Plus, SmartPlant 3D Materials Handling Edition, SmartPlant Explorer, (sites, SmartPlant reviews)

Lauterbach Verfahrenstechnik - makers of modular software for **pressure vessel design, plant design**

Piping Design Software



Neilsoft - **engineering services** catering to CAD/CAM/CAE/plant engineering sectors

PapriCAD - **piping and electrical plant** drafting application, powered by AutoCAD OEM, comes equipped with its own platform, by Procad Software

Pipecheck - **innovative pipeline** software platform that addresses pipeline external **corrosion**, pipeline **mechanical damage**, by Creaform

PipeDesigner 3D - **creates 3D parts** on demand from extensive customizable database, for mechanical contractors, engineering firms specializing in **process piping**, other general piping systems, from QuickPen International (reviews)

Plant-4D - **plant design** system for both AutoCAD, MicroStation, from CEA Technology

ProCAD - **piping design** software in 3D/2D Discount CAD software at CADdepot

Piping Design Software



Pro/ENGINEER Routed Systems Solutions - **suite of programs** helps designers, packaging, manufacturing engineers to design, route, document, produce complex harness, **piping systems, from PTC**

PV Elite - software tool for **vessel, heat exchanger analysis, design, evaluation**, by Intergraph

ROHR2 - program system for **static, dynamic analysis** of **complex piping, skeletal structures**, by **SIGMA GmbH**

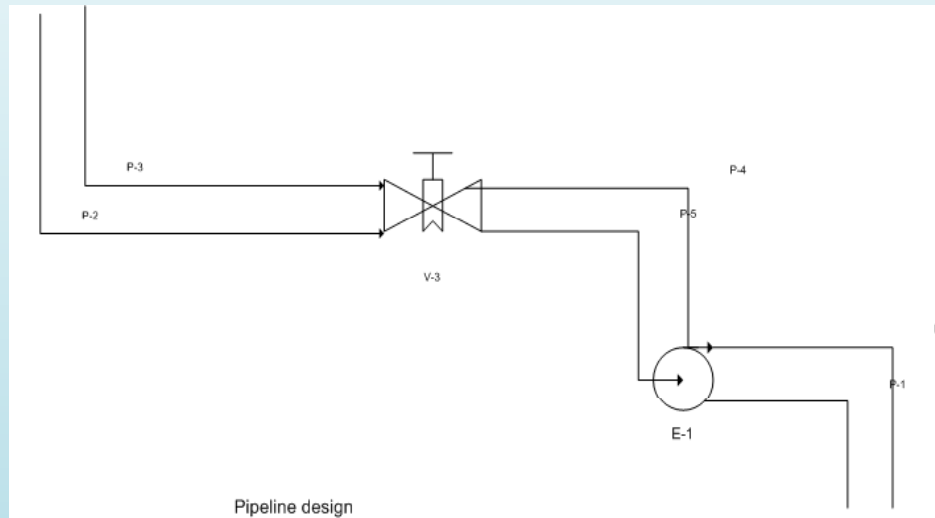
Simulation Sciences Inc. - makers of **process control, optimization, simulation** software, including the Process Engineering Suite, **PIPEPHASE**

Smap3D new - provides **3D CAD** software solutions for **planning, construction, data management**, by CAD Partner GmbH

SmartPlant P&ID - **optimizes**, design quality of **plant life** cycle, integrates with electrical, piping, data management, by Intergraph

Tahoe Design Software - maker of **piping design, pump selection** software, custom selection software can be used with TDS product promotion CDs to promote products with multimedia

Microsoft Visio



Pipeline List						
Displayed Text	Description	Line Size	Schedule	Design Pressure	Design Temperature	Quantity
P-1						1
P-2						1
P-3						1
P-4						1
P-5						1
P-6						1

How to Use Design Software

To start with, we will watch design software videos:
[AutoCAD 2015](#) (15min); Solidworks [link](#) (5min)