A Survey of Model Selection for Oil and Gas Pipeline Design using Domain Specific Modelling

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ABSTRACT

Pipeline engineering in the oil and gas industry is a technical domain that addresses issues such as pipe and fluid flow, pressure, temperature, solid modelling, concurrency, and other issues related to pipeline design technical content. Presented in this paper is how a Domain Specific Modelling System (DSMS); a software description, can actually be useful to oil and gas pipeline engineers at their work place. It is intended to aid the engineer bring up designs of a pipeline project at start up for fluids transmission before proceeding to fabrication. Once stakeholders have produced a proof of concept for any particular pipeline project that needs to convey oil or gas; the next step is usually to consult computer aided design (CAD) experts so that the desired pipeline models can be developed for onward fabrication and subsequent laying of the pipeline network. Therefore instead of the stakeholders spending so much consulting; this system can be used to create the designs through selection of the appropriate models that clearly reflect the design intents. In this way it is intended to boost productivity, and also take away the complexities of time consuming syntax oriented developments associated with conventional modelling systems.The domain specific modeling (DSM) paradigm was adopted to aid the pipeline engineer in the design and implementation of the pipeline configurations

Keywords: *Potential design, Salient characteristics, Pipeline systems, Conceptual linkages, Pipe and fluid flow*

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I. INTRODUCTION

This work is centered on the propagation of a research software to a workable standard in the oil and gas pipeline engineering industry. Pipeline engineering is a technical domain that addresses issues such as pipe and fluid flow, pressure, temperature, solid modelling, and concurrency, and other issues related to pipeline design technical content [1]. One issue of concern again in the software adaptation processes to oil and gas pipeline is to see how the pipeline engineering issues are mapped to the appropriate concepts in the domain. With these mappings significantly addressed in the software logic; the design, evaluation and implementation of transmission pipeline configurations can become successful. Having looked at pipeline engineering [6], all the salient technical characteristics prevalent with oil and gas pipeline domain were therefore prescriptively defined, so the specifications can be implemented. To this end, a domain specific modeling system (DSMS) is developed to aid the pipeline engineer create designs that fits the proposed project by simply selecting the appropriate models [10]. The approach to the development of the modeling language was derived from the domain specific modeling (DSM) paradigm of model driven engineering (MDE) technologies; it was adapted to the complex problem of efficiently and effectively aiding the engineer in the design and implementation of the pipeline configurations [4].

II. RELATED WORK

Germanischer [9] in his service/product description for pipeline management solutions presented a more detailed method statement. In their methodology, all aspects of a pipeline's current and future operations can be simulated, providing operators with unprecedented information on the pipelines current and future states, and a veritable "solution framework" for planners, engineers, operators and managers. Pipeline management solutions are provided in a lot of areas ranging from analysis and planning to user defined modules, leak detection to geospatial information system management, application models for user interaction to integrated design management.

However, in our approach, detailed functional and non-functional requirements analysis is incorporated. It is to allow for a description of the system concrete syntax and component parameters of a typical pipeline system. One major disadvantage with ours is the non-inclusion of an analysis module that allows stakeholders to perform domain analysis via the system. Also in our system, thorough performance evaluation cannot be performed without the presence of domain experts, but with energy solutions, system performance evaluation can conveniently be measured without the inputs of domain experts [15]. DSMSs can be graphical, constraint-based, textual or descriptive, and can be executable [19]. Graphical modelling languages use diagram techniques with named symbols that represent concepts and relationships. A typical graphical modelling language is *Behaviour Trees*. Textual modelling languages use standardized keywords accompanied by parameters to make computer-interpretable expressions. An example is *TVL* (A Text-based Variability Language) [20]. Constraints-based modelling languages do not specify a step or sequence of steps to execute, but rather the properties of a solution to be found. Typical examples include Very High (Speed Integrated Circuit) Hardware Description Language (VHDL), and AutoCAD.

Executable modelling languages often include the idea of code generation: automating the creation of executable source code directly from the domain-specific language models. An example is SysML (Systems Modelling Language). The structure and behaviour of domain specific modelling for possible model selection in a typical pipeline design as rightly highlighted in [10], intend to create integrated functionality with a model transformation capability, allowing the user the flexibility of working with familiar notations, and yet able to effectively express the constraints and limitations of the proposed network [15]. The design of a pipeline system requires the knowledge and application of theory from a number of engineering principles and standards such as physical attributes, and materials factors.

Physical attributes are those parameters that govern the size, layout, and dimensional limits or proportions of the pipeline [16]. The focus of Jonathan Sprinkle et al. [14] is more closely related on endogenous refinements where the source and target share the same metamodel, or a metamodel with only evolutionary changes. This work adopted the same approach to model transformation, but the bit of new thing we seem to have added is the graphical domain model to a textual application model. Our language functionality is closely tied to the DSM manifesto, raise the abstractions in which case the language metamodel represent concepts from a single domain and one pipeline context model. MattijsGhijsen et al. [17] adopted multi-paradigm modelling that combines discrete behaviour, e.g. (state machines) with continuous behaviour of system flow, (e.g., differential equations). This is typical of combination of several domains and various models of computation. Despite the benefits that multi-paradigm modelling offers, there is the challenge of adaptation across the concepts that may be represented. What is possible in this survey is the representation of semantic relationships among the domain concepts [4]. Sylvanus and Shenghong [3] also presented a model for path analysis based on full paths. This model was developed to provide a lot of useful information about users' navigation through a website. The principle is that all the data in a user's session along the paths are visually displayed. The basic consideration in this research is the fact that the model as also in this context does all the representations effectively in order to actualize the visual display of the user's active session.

III. MODEL SELECTING SYSTEM WORK FLOW

During domain analysis phase, quite a lot of inputs regarding pipeline design criteria were sequenced through technical documentations [10]. The knowledge acquired became the domain knowledge for the formal analysis and subsequent construction of the model selection system via feature oriented domain analysis (FODA).

3.1 System Work Flow Mechanics

Some of the key requirements for the system work flow are as follows:

1. A semantic model should be included as a feature of the Domain Specific Modelling System.
2. The Domain Specific Modelling System has to have a user interface component with familiar notations, permitting its users to represent their mental models about their design intents.
3. Users should be able to define modelling parameters in line with pipeline engineering principles.
4. Users should be able to interpret artefacts.

The feature oriented domain analysis (FODA) technique [5] as illustrated in figure 1 is used for the domain analysis; to produce the formal analysis models. These models, including the modelling primitives, and composition rules were created. The composition rules exemplify the primary relationship between the pipeline atomic and composite features.

This oil and gas transmission pipeline modeling software is an analytic platform [5] for evaluating decisions related to oil and gas pipeline design project strategy and development. As stated in [5], the software can help oil and gas companies optimize their selections and gain insights into their pipeline transmission performance potential and their strategic alternatives at the business level. This is done in the context of the existing description of concepts with the determining factors accommodated in system design. Also optimal solutions are derived from the determining factors to address decisions involving risks and uncertainties, and their opportunities and objectives [19].

3.2 Basic Assumptions

Adopting the Domain Specific Modelling (DSM) paradigm in the design of the system means that it is basically a domain Specific Modeling Language (DSML) that is intended to be used in the domain of Oil & Gas Transmission Pipelines [18]. It is to serve to create conceptual models of the domain relating to differing Pipeline Engineering Projects; which invariably are the design scenarios for which the models are selected to represent using the DSM logic for Oil & Gas Transportation [3]. Therefore the assumptions underlying the software delivery process are:

1. stakeholders can freely express their design intents
2. the system simply offers familiar semantic primitives only to oil and gas transmission pipeline mechanisms
3. the highest priority is user satisfaction through continuous delivery of valuable reusable software
4. the system defines components possible interactions for the artefact orientation

3.3 The Models of Computation

Some description of the design models for the pipeline design modelling language are given in this section [1]. The design, construction, operation, and maintenance of various pipeline systems [19] involve understanding of piping fundamentals, and materials. Such materials include pipes, flanges, fittings, bolting, gaskets, valves, and the pressure components. It also includes pipe hangers and support components. The models in consideration are AutoCAD objects that depicts [12] the typical pipeline components, which invariably forms the DSM objects. The models of computation targeting the domain are AutoCAD objects, which represents the description of domain concepts useful in creating the modelling instances [2].

Physical attributes considered are:

1. Size
2. Layout
3. Dimensional limits or proportions of the pipeline

Physical components are the models:

1. Pipe
2. Fittings and joints
3. Pump
4. Supports
5. Instruments

These physical components are as illustrated in Figure 2.

The pipe cross section as shown in figure 3 is the major component in the pipeline, linked and connected by other components [17]. To obtain our pipeline context model of the pipe, the nominal diameter or outside diameter and the inner diameter of the pipe dimensional standards were specified. Also specified are the pipe directions (from point to point), the pipe length, and slope [11]. The specifications were made particularly to get a simple uniform pipe sizing in the pipeline. The pipe design was accomplished from AutoCAD by the sweep method using polyline from the draw tool bar.

Physical piping components in a pipeline project include pipe, flanges, fittings and joints, bolting, gaskets, valves, and the pressure containing portions of other piping components. It also includes pipe hangers and supports and other items necessary to prevent over pressurization and overstressing of the pressure-containing components [13]. It is evident that pipe is one element or a part of piping. Therefore, pipe sections when joined with fittings, valves, and other mechanical equipment and properly supported by hangers and supports result into a pipeline system.

Pipeline support design was accomplished from AutoCAD through the usage of a cylinder or a box, to achieve a circular or a square base of an appropriate height, and arrayed into four places in such a way that the pipe or whatever it is supporting can easily feat into the center of the arrayed space [14]. Pipeline physical components design relating to tank or storage, bolts and nuts, flanges, tees and elbow are obtained from the appropriate AutoCAD tools such that the polygonal tool is used to design bolts and nuts, the sweep method is also applied in designing elbow by drawing lines with angles of 90, 60, 45, 30 degrees as required. Bolts also included are externally threaded and are intended for fastening joints with nuts, especially to provide bearing connection and slip-critical connections between two components in the pipeline [13].

Flanges, tee, and storage physical components as shown in figure 5 are designed via subtraction between two cylindrical heights and arrayed into six or eight places.

To design a tee, a hollow pipe earlier drawn is sliced and placed to each other and then joined together to form a shape like the letter “T”- from where the name was derived. Storage design is accomplished through the usage cylinder and sphere with the application of slicing whereas reducers are designed through the combination of a hollow cylinder and cone frustum and achieved through subtraction with the diameter of one end of the cylinder corresponding to the bigger end of the cone frustum [2].

3.4 Joint Component Design

Joint is a connection between two lengths of pipe or between a length of pipe and a fitting. There are quite a lot of types of joints in a pipeline system, each dependent on the service orientation in the pipeline project. The pipeline design is achieved by careful selection of appropriate fittings as specialized pieces of pipes that connects other pieces together [5]. This connection results in a network of pipes that can allow transmission of gas or other liquids from source to destination [16]. The major concern is the design of a pipeline system that is straight forward and as short as possible.

The mentioned considerations are discussed for a number of common pipeline joints and fittings configurations as part of a typical pipeline project. Butt-welding is the most common method of joining pipes used in large commercial and industrial piping systems. Socket-welded construction is a good choice wherever the benefits of high leakage integrity and great structural strength are important design considerations [8]. The main advantages of the grooved joints are their ease of assembly, which results in low labour cost, and generally good leakage integrity. The grooved construction prevents the joint from separating under pressure [20]. The compression joints are used to join plain end pipe without special end preparations. Advantages include the ability to absorb a limited amount of thermal expansion and angular misalignment and the ability to join dissimilar piping materials, even if their outside diameters are slightly different. The model is as shown in figure 6 with the necessary dimensions [5].

Flow meters and valves as shown in Figure 7 are as well designed accordingly with cylinders and appropriate graphics dimensions. In all of the designs appropriate materials are added from the material tools kit or materials browser to improve the finishing. Other models such gauges, strainers, gaskets and meters are necessary considerations in a pipeline design project [12]. Especially, pressure gauges are mounted to provide a means of monitoring the equipment; strainers help to keep solids out of the pump and the pumping system.

Pressure containing components such as gauges and meters carries sufficient pressure metrics for the inputted fluid /pipe surface relationships.

IV. SYSTEM REQUIREMENTS

In this section, some informal requirements definition documentation describing the domain of oil and gas pipelines design system are given in more detail. These requirements include design specifications for pipeline physical assets such as pipes, valves, and active equipment (pumps, compressors, etc., also referred to as dynamic or rotating equipment). Others include fixed equipment (vessels, heat exchangers, etc., also referred to as static equipment), in-line components (traps, strainers, etc.), instrumentation, and insulation and supports [14]. Also required is the ability of the system to provide engineering support, prototyping support and design services to clients across the oil and gas, and other areas of operations in the oil and gas pipeline industry. This capacity extends to leverage domain and technology expertise in order to find answers to processes and infrastructure delivery excellence in the oil and gas pipeline industry [7]. Domain specific modelling, which focus more on requirements within a particular domain can make this support possible through pipeline network delivery and responsive solutions tailored to meet specific requirements of customers. Therefore the system can now possibly answer to domain focused oil and gas centers of excellence [1].

4.1 Design Mechanism and Scenarios

Oil and gas pipelines design scenarios, either onshore or offshore are usually set off by increasingly complex challenges in the exploration and development of energy resources. Successful execution of the design systems therefore requires innovation and creativity, and the passion to deliver [4]. Oil and gas pipeline companies generally prefer to operate their systems as close to full capacity as possible to maximize their revenues. In order to actualize the planned revenue margins, some variables such as safety, technical, financial, environmental, regulatory, and logistics and culture need to be considered for the effective execution of the design systems. This is actually one development strategy where design projects in the domain integrate storage capacity into the pipeline network design so as to increase average utilization rates. This integration will then showcase designs that are capable of balancing flow levels by moving products to and from storage facilities [11].

Major circumstances in pipeline design are the inclusion of expansion parameters and control. This depend on the fact that a pipeline development or expansion project involves several steps ranging from determining demand/market interest, project announcement, obtaining regulatory approval to construction and testing scenarios. Necessary options for inclusion of expansion capacities in the design dimensions are addition of looping; which means adding a parallel pipeline along a segment of pipeline, addition of features for the building of an entirely new pipeline, and features for upgrading and expanding facilities, such as compressor stations, along an existing route [21]. A typical pipeline that transports fluids is expected to maintain uniform flows. To achieve this, standard design methods are selected. Selection of any such design method is dependent on some functional and non-functional variables.

4.2 Functional Requirements

Oil and gas pipelines similar to other pipelines like waste or water carry crude oil or gas from oil wells and gas storage facilities to tank farms for storage or to refineries for processing and to points of utilization [8]. Piping includes pipe, flanges, fittings, bolting, gaskets, valves, and the pressure containing portions of other piping components [15]. It also includes pipe hangers and supports and other items necessary to prevent over pressurization and overstressing of the pressure-containing components. It is evident that pipe is one element or a part of piping.

Therefore, pipe sections when joined with fittings, valves, and other mechanical equipment and properly supported by hangers result into a pipeline system [9]. A mechanism for oil and gas pipelines design should include functionalities. The system should showcase a pipe**.** Established pipe sizes should be designated approximate inside and outside diameters with appropriate standardizations such as nominal pipe size(NPS) and Diameter nominal (DN). The pipeline should contain nozzle specifications, pipe alignment guide and supporting fixtures, pipeline or transmission line, and pressure functionalities.

4.3 Non Functional Requirements

The component modules in a typical oil and gas pipelines design system should communicate effectively to give maximum throughput. The system should provide support for storing, updating, and accessing relevant information on both archived and on-going design projects relating to type of modelling paths and materials selection, location of data structures for effective design, resources allocation options, software logic decision trees, step-by-step guide to resolving design crisis, and links to alternate strategies [2].

The system should be able to capture as input user concepts and process same to produce applicable design products in the domain. It should define access policies for various categories of users. The access policy shall describe the components and information each personnel may add, access, and update.

V. COORDINATING THE FUNCTIONALITIES

The software process involves updating the products to real time industry standards capable of translation into structural forms [20]. The adoption of the domain specific modelling paradigm has made it possible to enable the system become layers of re-useable software capable of meeting the specific design needs of the stakeholders. The prospect is that all the pipeline physical components represented from AutoCAD design tooling suite are crafted into concrete modelling primitives and for the abstract metamodeling entities using the requirements [7]. The enhancement features as specified in the models of computation will enable the software internal mechanism match the user's mental model of the problem domain, maximally constrain the user (to the problem at hand), easier to learn, and avoid errors [18]. This power will ensure design optimization to quickly arrange through varieties of options and combinations. The results will identify the optimal mix of any new proof of concepts for projects, expansions, and acquisitions. In the context of our DSML model, the semantic representation has clearly indicated the data binding process to be an object valuation tendency that specifies the event states as shown in Figure 8.

```
select the design operation.Enter 1 for Pump selection, 2 to calculate the system tot
start building the different Routes. Enter 1 to continue or press 2 to exit1
enter 1 for components, 2 for joints and 0 to complete/exit1
select a component. Enter 0 to exit, 1 for Pipe, 2 for Elbow, 3 for Reducer, 4 for va
enter the internal diameter of the Pipe (inches):28
enter the Pipe length (mm):79
enter 1 for components, 2 for joints and 0 to complete/exit2
select a joint. Enter 1 for Flange, 2 for Tee, 3 for other joint types and 0 to exit2
enter the Tee length (mm):69
enter the Tee minor loss coefficient. Be aware of the Tee types:0.8
enter 1 for components, 2 for joints and 0 to complete/exit1
select a component. Enter 0 to exit, 1 for Pipe, 2 for Elbow, 3 for Reducer, 4 for va
enter the internal diameter of the Pipe (inches):28
enter the Pipe length (mm):86
enter 1 for components, 2 for joints and 0 to complete/exit2
select a joint. Enter 1 for Flange, 2 for Tee, 3 for other joint types and 0 to exit3
enter the other joint length (mm):45
enter the Vjoint type minor loss coefficient. Be aware of the Joint types:0.6
enter 1 for components, 2 for joints and 0 to complete/exit1
select a component. Enter 0 to exit, 1 for Pipe, 2 for Elbow, 3 for Reducer, 4 for va
enter the internal diameter of the Pipe (inches):28
```

Figure 8: Model Selecting Event States

The events become more vivid as text inputs from the application model are continually made possible for the functionality of the internal representations, particularly on the root node of the model [21].

VI. CONCLUSION AND FUTURE WORK

The software breeding process is currently in progress and when completed will become a standard for modelling pipeline designs in the oil and gas pipeline industry. This is a standard that will be consistent with valuation data throughout design interests and divisions in pipeline projects that can account for investment decisions with greater confidence. More structured design analysis and processes for more consistent economic evaluations will become possible. Also possible will be a secure and scalable model selection process for onward fabrication that can enhance business in these directions. Usually, adoption of DSM approach in software processes leads to a Domain Specific Modelling Language (DSML), which invariably means that the processes will involve multi-user and transmission pipeline physical asset-wide level implementation. To this end, the relevant models have to be selected in a controlled environment where data access is only familiar and limited to stakeholders' views.

REFERENCES

[1] Afredo Capozucca, Betty H.C, (2013) Requirements definition document for a software product line of car crash management systems https://www.cs.colostate.edu/TechReports/Reports/2011/tr11-105.pdf last retrieved 25-06-2020.

[2] Autodesk Inc. (2019) *AutoCAD Programmers Reference* https://www.autodesk.com/developer-network/platform-technologies/autocad

[3] S. A. Ehikioya, S. Lu. ''A Path Analysis Model for Effective E-commerce Transactions'', African Journal of Computing & ICT , Vol. 12, No. 2, June 2019, pp. 55 - 71 ISSN 2006-1781 https://afrjcict.net

[4] Braha D, Reich Y (2001) Topological structures for modelling engineering design processes. International conference on engineering design (ICED 01), Glasgow http://pascal-francis.inist.fr/vibad/index.php?action=getRecordDetail&idt=15333338

[5] Feature-Oriented Domain Analysis (FODA) http://www.sei.cmu.edu/reports/90tr021.pdf; retrieved from https://resources.sei.cmu.edu/library/asset-view.cfm?assetid=11231 25-06-2020

[6] Bashar Nuseibeh, Steve Easterbrook*: Requirements Engineering: A Roadmap*. Department of Computer Science, Imperial College https://www.cs.toronto.edu/~sme/papers/2000/ICSE2000.pdf retrieved last 25-06-2020

[7] B. Zarrin (2017), 'Domain Specific Language for Modeling Waste Management Systems', Technical University of Denmark DTU Compute PHD-2016, No. 407, PhD Thesis, Department of Applied Mathematics and Computer Science; https://backend.orbit.dtu.dk/ws/portalfiles/portal/141044051/PhD407_Zar rin_B.pdf

[8] B. R. Japheth and P. O. Asagba (2015), 'Oil and Gas Pipeline Design Management System: A Case Study for Domain Specific Modeling', American Journal of Software Engineering and Applications, Vol. 4, No. 5, pp. 92-98.

[9] L. Germanischer (2008) Energy Solutions Pipeline Management Solutions Industrial Services GmbH Oil and Gas Steinhöft 9 20459 Hamburg, Germany glis@gl-group.com www.gl-group.com/glis

[10] Bunakiye R. Japheth and Acheme I. David (2017), 'Defining a DSL for Transmission Pipeline Systems Meta-Modeling', Future Technologies Conference(FTC), 2017, Vancouver, Canada.

[11] Hans Vangheluwe (2010), (Domain-Specific) Modelling Language Engineering. Lisboa, Portugal , McGraw Hill, New York, USA.

[12] Igulu Kingsley Theophilus, Piah Z. Patrick, Japheth R. Bunakiye and Georgewill Moses Onengiye (2016), 'Mmodel Interactions in a Domain Specific Modeling Language: An ICT Solution to Transformations in Design of Fluid Supply Systems', International Journal of Advanced Research in Computer and Communication Engineering, Vol. 5, Issue 6, pp. 405 – 410.

[13] Jag Sodhi and Prince Sodhi (1999), Software Reuse: Domain Analysis and Design Process Computing, McGraw-Hill, USA.

[14] Jonathan Sprinkle, Jeff Gray, and Marjan Mernik Fundamental Limitations in Domain-Specific Modeling Language Evolution University Of Arizona, Ece, Technical Report #Tr-090831 1 2010.

[15] S. Katz, Crisis Management Systems: A Case Study for Aspect-Oriented Modeling et al. (Eds.): Transactions on AOSD VII, LNCS 6210, pp. 1–22, 2010. _c Springer-Verlag Berlin Heidelberg 2010

[16] Anvil International (2012), Pipe Fitters Handbook, University Park, IL 2012, McGraw-Hill, United States.

[17] Franklyn Turbak and David Gifford, (2008), Design Concepts in Programming Languages The MIT Press Cambridge, Massachusetts London, England

[18] Denis Jose Schiozer, Antonio Alberto de Souza dos Santos, Susana Margarida de Graca Santos and Joao Carlos von Hohendorff Filho (2019), 'Model-based Decision Analysis Applied to Petroleum Field Development and Management', Oil Gas Sci. Technol., Vol. 74, Article 46; https://doi.org/10.2516/ogst/2019019

[19] Brooke Hamilton, Strategies for Generating Code from Microsoft DSL Tools Using T4 Text Templates; hamiltonbrooke@yaho.com T4 Documentation on MSDN https://docs.microsoft.com/en-us/visualstudio/modeling/code-generation-and-t4-text templates?view=vs-2019

[20] Classen, A.; Boucher, Q. and Heymans, P. A Text-based Approach to Feature Modelling: Syntax and Semantics of TVL. In Science of Computer Programming, Special Issue on Software Evolution, Adaptability and Variability, 76 (12) December 2011, Pages 1130-1143 https://doi.org/10.1016/j.scico.2010.10.005

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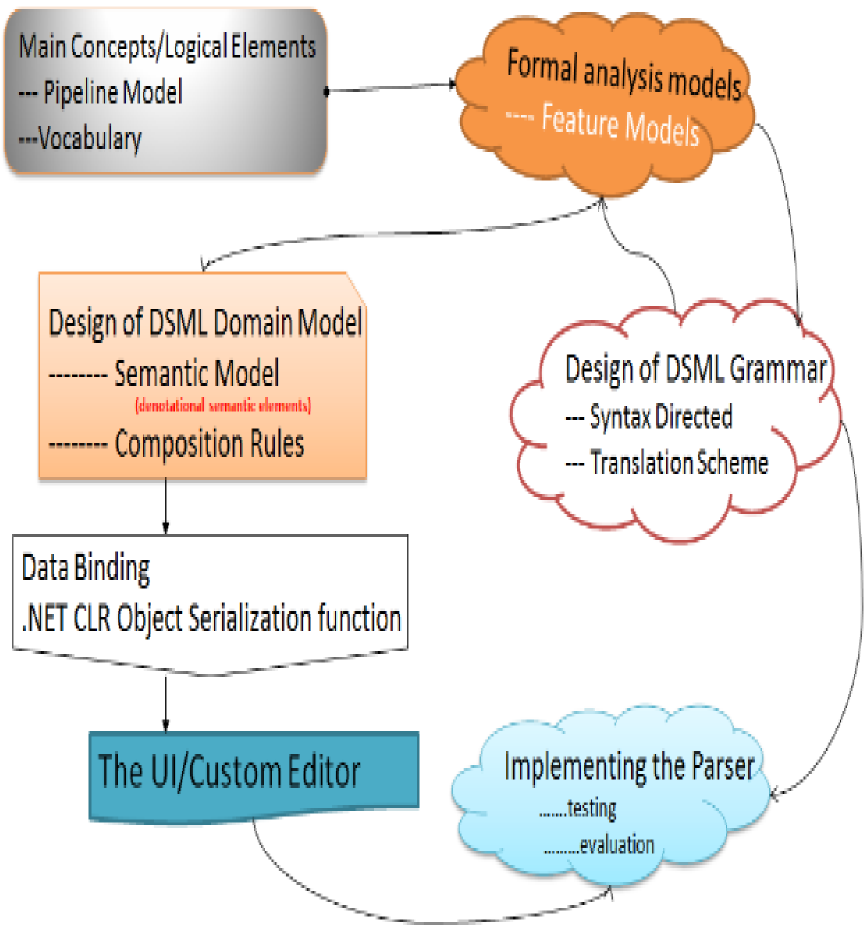

Figure 1: System Work Flow

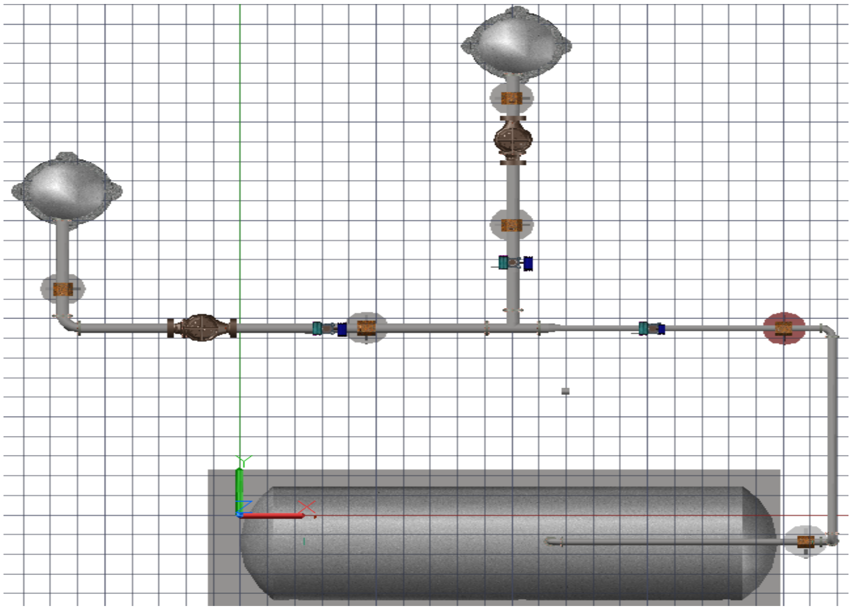

Figure 2: Pipeline Model with Gauges Fittings (Source: [2])

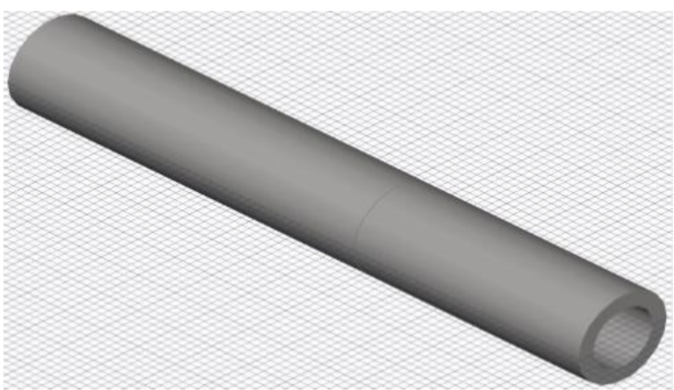

Figure 3: Pipe Cross Section Model (Source: [2])

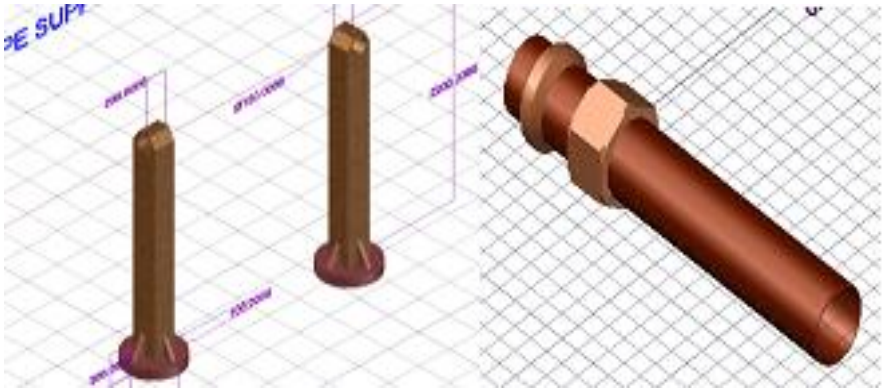

Figure 4: Pipeline Support Models (Source: [2])

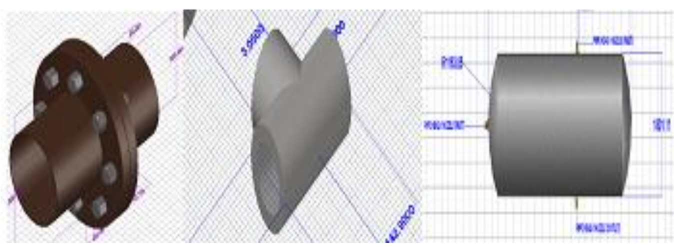

Figure 5: Flanges, Tee, and Storage Component Models (Source: [2])

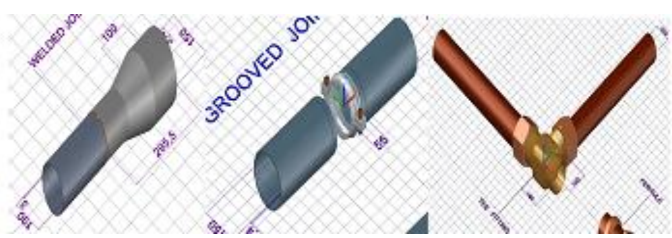

Figure 6: Pipeline Joint Models (Source: [2])

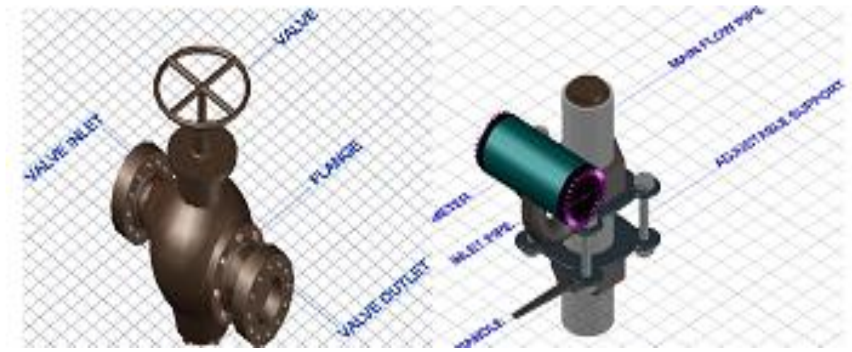

Figure 7: Valve and Flow Meter Models **(Source: [2])**