NVH Model Integration and Configuration Complexity Handling Tool using ANSA

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ABSTRACT –
To compete in the modern automotive industry there is a heavy reliance on engineering analysis through CAE. The CAE community has been continuously challenged to build and analyze more vehicle configurations to improve quality and reduce overall R&D expenditure. To accomplish this, efficient tools are needed to build and integrate various vehicle configurations using standard model integration methods to improve quality and data sharing.

An efficient tool to integrate NVH CAE models based on vehicle configurations utilizing ANSA Include Manager was developed. This tool automates model integration, handles configuration complexity, eliminates duplication of effort, increases quality, and standardizes the process. This tool enables building and analyzing more vehicle configuration models while improving quality of NVH CAE assessments.

At the heart of this tool is ANSA Include Configuration Manager. Vehicle configurations are defined in an ANSA file and called as needed. Once requested, the include manager picks the appropriate subsystems and assembles the model. Other auxiliary data for assembly is read through an ASCII file. The final model is exported as an analysis deck with subsystems as include files or embedded models based on the options selected. Several check points and flags are incorporated into the tool to make the process robust. Model updates is easily accomplished by swapping the subassemblies in the include manager and updating the corresponding data in ASCII file.

INTRODUCTION

CAE simulation of full vehicles requires integration of various vehicle sub-systems together with the appropriate connections between them. Creating different configurations of a vehicle requires identifying the required sub-system models and integrating them. This process gets complicated as the number of configurations that need model updating. Efficient tools are essential to accomplish this task. The main deficiencies of the current process are lack of GUI and pre-processor interface, configuration handling capability and user friendliness. The new process and tool developed in Phase 1 overcomes most of the above mentioned drawbacks. It makes the integration process more seamless, robust, and efficient. Phase II is planned to further automate the process to improve the efficiency.

MODEL INTEGRATION PROCESS

Full vehicle integration consists of the four main steps. The sub-assemblies are prepared for full vehicle integration in step one. This is done by renumbering and naming the sub-assemblies and attachment points based on a standard numbering scheme and naming conventions. Step two involves identifying sub-assemnblies needed for specific vehicle configuration. In step three, connections between the sub-assemblies are defined. Finally, in step four, all the sub-assemblies are integrated using the connetion definition from step three. This process is repeated for all vehicle configurations. The biggest challenge in this process is to make sure that all sub-assemblies across all configurations are of same release level and all common connection information is consistent.

INTEGRATION PROCESS USING ANSA AND THE ROLE OF THE NEW TOOL

1. PREPARING SUB-ASSEMBLIES

The sub-assemblies are renumbered in ANSA based on pre-determined standard numbering scheme. This process is manual at this point of time and will be automated in phase II of tool development. The attachment points are named automatically according to the connection template using the new integration tool. Once the subassemblies are prepared, they are organized in a standard directory structure. This step is necessary to make sure that different revision levels of the sub-assemblies are tracked in a consistent way. This also ensures that there is no duplication of common sub-assemblies as all the configurations refer to the same location.

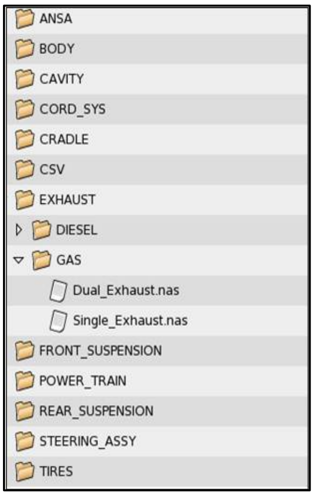


Figure 1 - Folders Structure in ANSA

2. CONFIGURATION GENERATION

Various configurations are generated in this step using ANSA Include Manager. First, the root of the data folder is selected where all of the sub-assemblies are organized. This will populate the tree structure of the directory along with all the sub-assemblies. Once the tree structure is populated, a configuration list is generated. Each configuration consists of toggle switches for all available subassemblies. This allows the user to quickly pick the appropriate sub-assemblies for that particular configuration. This process is repeated to create as many vehicle configurations as needed. Automating the above process using GUI yielded significant efficiencies.

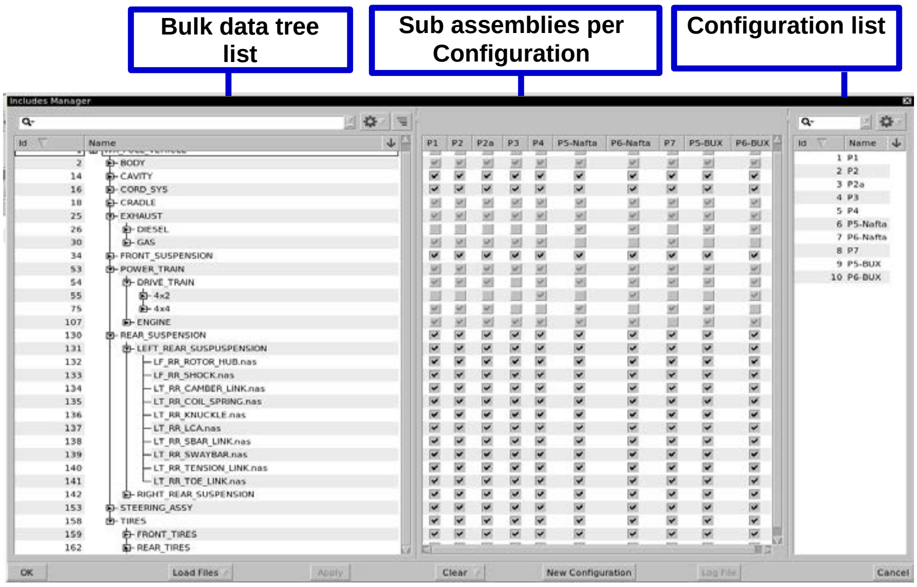
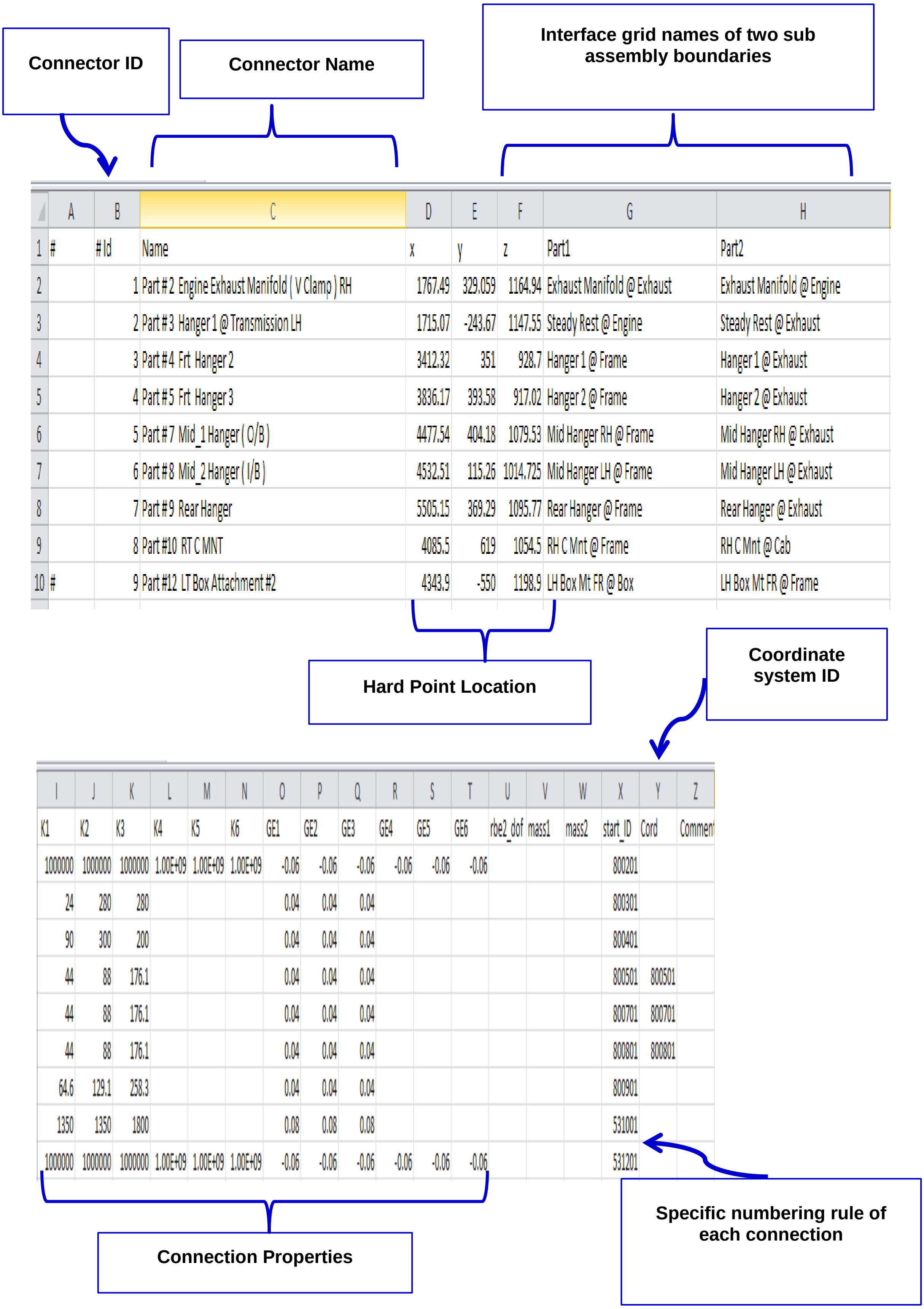


Figure 2 - Configuration generation window

3. CONNECTION DEFINITIONS

This is the brain of the tool where all the connection information comes together at a single location. All the information is defined and stored in .csv file which can be viewed easily in Excel spreadsheet. This sheet essentially consists of hard-point information, type of connections, coordinate systems and sub-assembly names. A specific numbering rule is followed for each connection. Toggle switches are provided to turn on/off any hard-point, if required. The main advantage of this GUI template is that all the connection information is stored in one place. The data can be retrieved, compared, or updated very quickly. This also ensures that the data is updated only once, thereby reducing redundancy and improving quality. This also helps to check and validate the data quickly without actually opening the master files.



	A	B	C	D	E	F	G	H
1	#	#Id	Name	x	y	z	Part1	Part2
2		1	Part #2 Engine Exhaust Manifold (V Clamp) RH	1767.49	329.059	1164.94	Exhaust Manifold @ Exhaust	Exhaust Manifold @ Engine
3		2	Part #3 Hanger 1 @ Transmission LH	1715.07	-243.67	1147.55	Steady Rest @ Engine	Steady Rest @ Exhaust
4		3	Part #4 Frt Hanger 2	3412.32	351	928.7	Hanger 1 @ Frame	Hanger 1 @ Exhaust
5		4	Part #5 Frt Hanger 3	3836.17	393.58	917.02	Hanger 2 @ Frame	Hanger 2 @ Exhaust
6		5	Part #7 Mid_1 Hanger (O/B)	4477.54	404.18	1079.53	Mid Hanger RH @ Frame	Mid Hanger RH @ Exhaust
7		6	Part #8 Mid_2 Hanger (I/B)	4532.51	115.26	1014.725	Mid Hanger LH @ Frame	Mid Hanger LH @ Exhaust
8		7	Part #9 Rear Hanger	5505.15	369.29	1095.77	Rear Hanger @ Frame	Rear Hanger @ Exhaust
9		8	Part #10 RT C MNT	4085.5	619	1054.5	RH C Mnt @ Frame	RH C Mnt @ Cab
10	#	9	Part #12 LT Box Attachment #2	4343.9	-550	1198.9	LH Box Mt FR @ Box	LH Box Mt FR @ Frame

I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
K1	K2	K3	K4	K5	K6	GE1	GE2	GE3	GE4	GE5	GE6	rbe2_dof	mass1	mass2	start_ID	Cord	Comment
1000000	1000000	1000000	1.00E+09	1.00E+09	1.00E+09	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06				800201		
24	280	280				0.04	0.04	0.04							800301		
90	300	200				0.04	0.04	0.04							800401		
44	88	176.1				0.04	0.04	0.04							800501	800501	
44	88	176.1				0.04	0.04	0.04							800701	800701	
44	88	176.1				0.04	0.04	0.04							800801	800801	
64.6	129.1	258.3				0.04	0.04	0.04							800901		
1350	1350	1800				0.08	0.08	0.08							531001		
1000000	1000000	1000000	1.00E+09	1.00E+09	1.00E+09	-0.06	-0.06	-0.06	-0.06	-0.06	-0.06				531201		

Figure 3 – Connections definition in Excel

4. CONNECTING SUB-ASSEMBLIES

The whole process of connecting the subassembly and writing the final deck has been automated with this tool using ANSA scripts. All the scripts are embedded into ANSA interface for quick access and ease of use. The final integration process is done using ANSA connection manager. The integration of the sub-assemblies can be done in two ways. If the user needs the full vehicle model, then the whole configuration is assembled by selecting the full vehicle button. If the user needs only partial model of a specific configuration then the user can pick only the necessary sub-assemblies from the configuration list. Once the sub-assemblies are selected, selecting the sub-model button would integrate the partial model. This will also ground the free boundary connections of the sub-systems. The final model can be exported as an analysis deck with sub-systems as include files or detailed models based on the options selected.

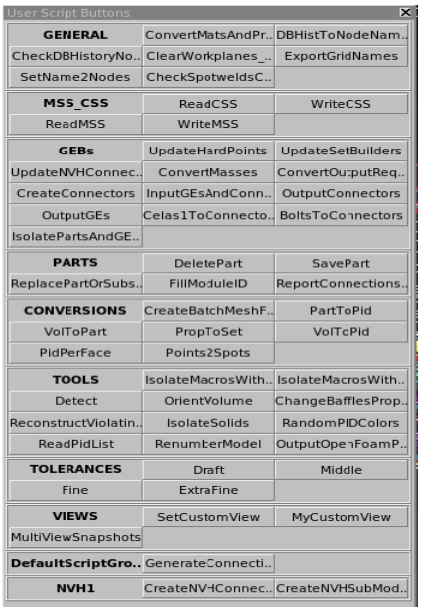


Figure 4 – ANSA interface for scripts

5. VALDIATION OF CONNECITONS

The conneciton scripts are designed to make the assembly process robust. Each connection is checked and validated at the time of integration. After completion of the integration process, an error list is populated with all of the failed connections and reason for failure. Usually the connections fail because of two main reasons. The first reason can be because of missing information in the .csv file. This can be easily fixed by updating the .csv file and rerunning the connection script. The second reason can be because of missing attachment points in the sub-assembly. This happens when sub-systems attachment points change because of design changes. Updating the .csv file with the new/updated information, updating the name and numbering of the attachment points as described in step 1 (preparing the sub-assemblies) and rerunning the connection script will fix the issue.

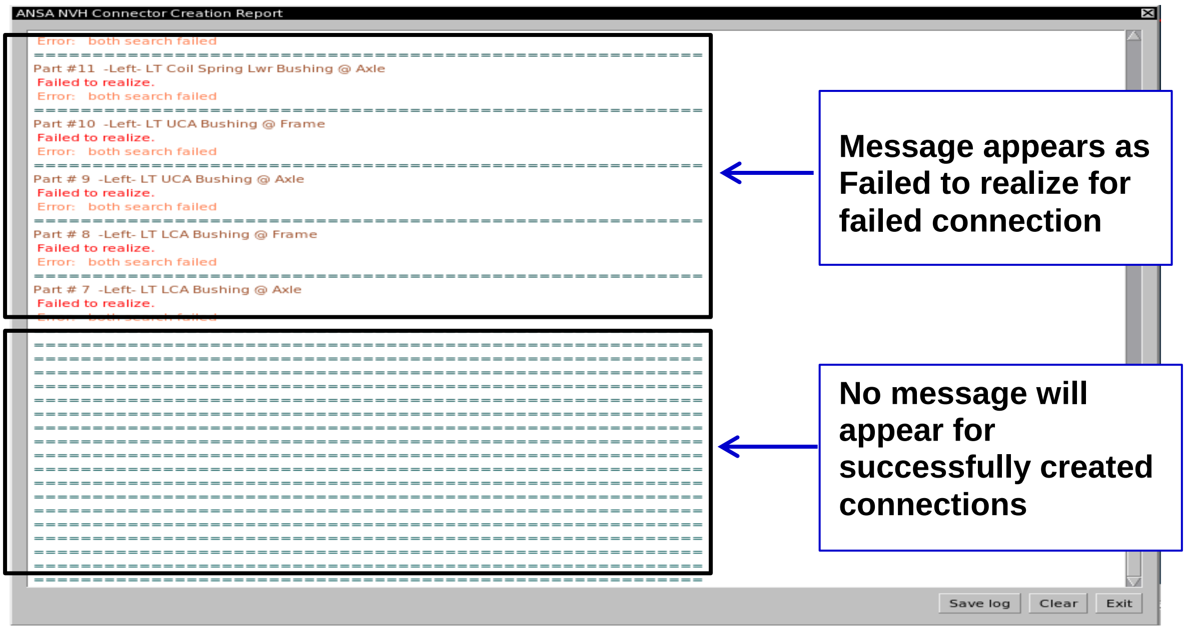


FIGURE 5 - Error list populated in ANSA

All the above five steps are seamlessly integrated with in ANSA preprocessor. This allows the user to fully take advantage of all the vast functionality and features of ANSA. The following chart gives a summary of overall flow of the data in the integrating process.

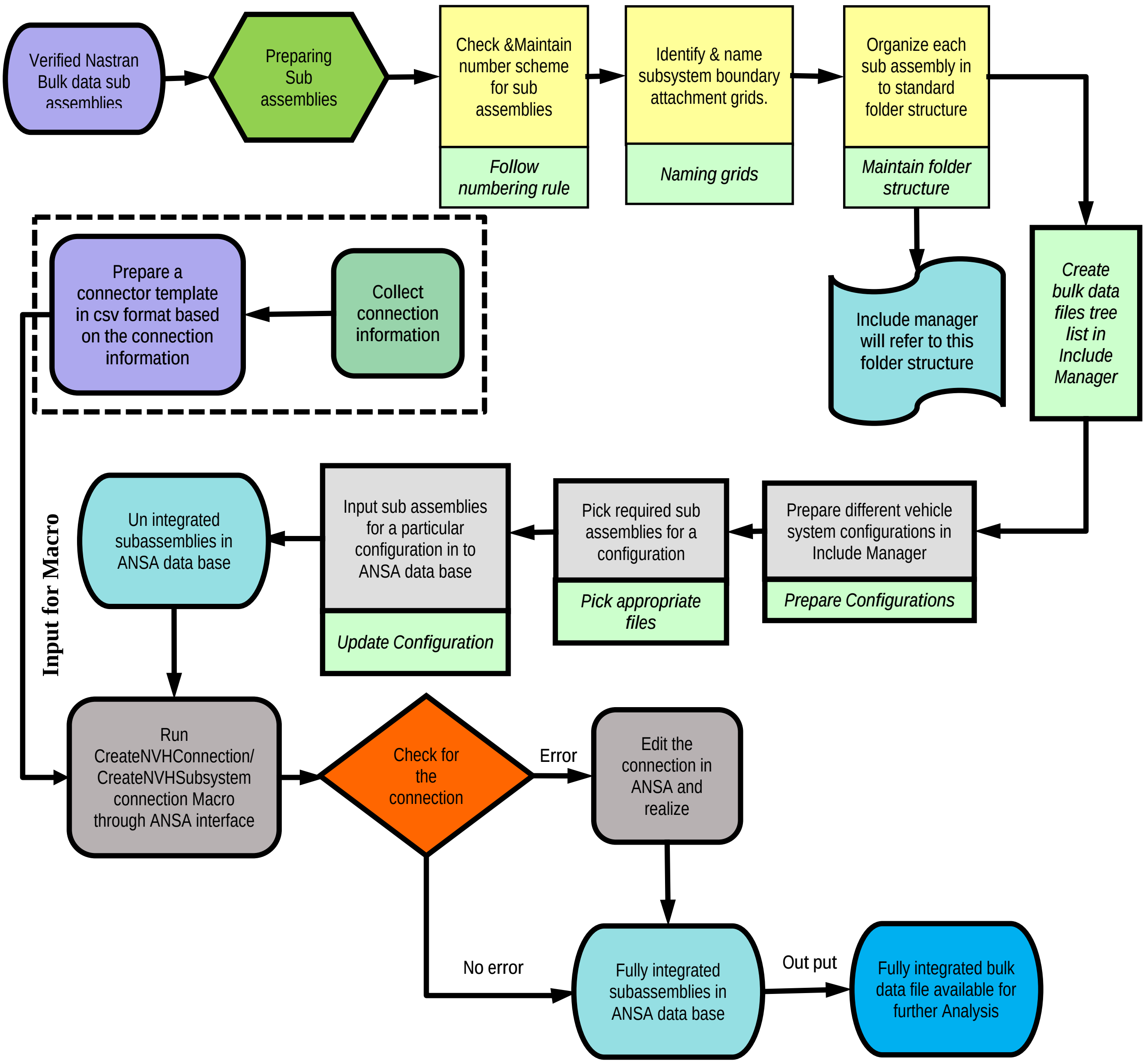


FIGURE 6 – PROCESS FLOW

CONCLUSIONS

CAE process standardization and automation allows tasks to be accomplished at a faster pace with consistent quality. This is achieved by using ANSA Include Manager and ANSA scripts to integrate CAE NVH models of different configurations. Seamless integration of the assembly process with ANSA pre-processor also results in reduced training costs and down time for new engineers.

REFERENCES

(1) ANSA version 12.1.5 User's Guide, BETA CAE Systems S.A., July 2008

ACKNOWLEDGEMENTS

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