Accompanying drawing (s) of the present invention: Method and computerized system for robust engineering and optimization of complex phenomenon.

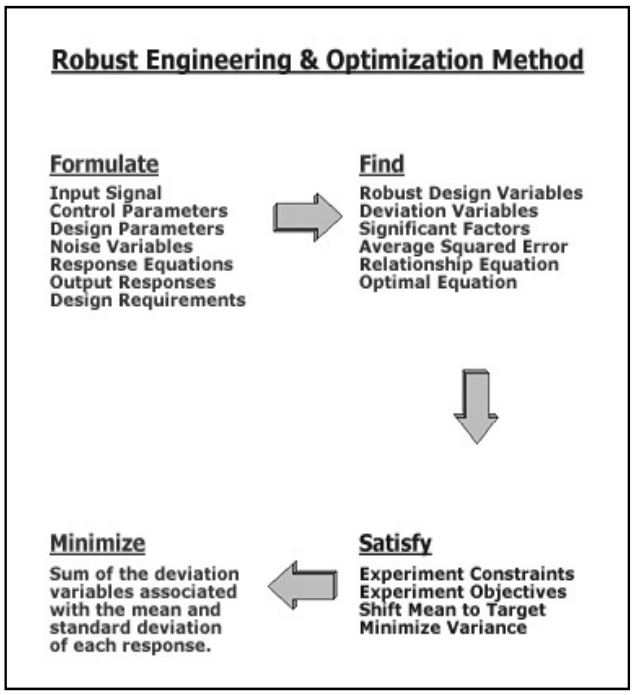


FIGURE 1: The generalized flowchart of the present invention.

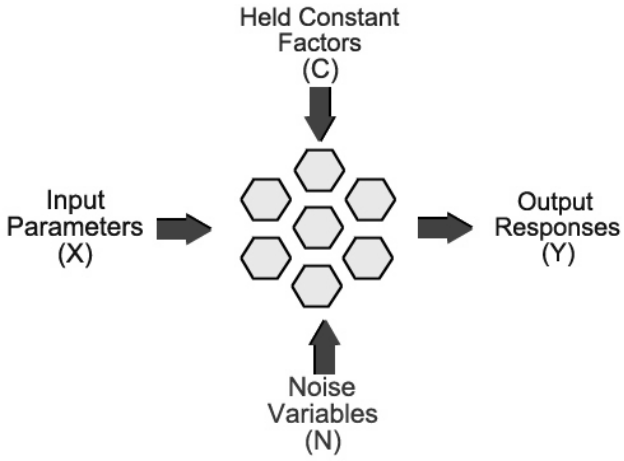


FIGURE 2A: Schematic view of a typical static optimization problem being studied.

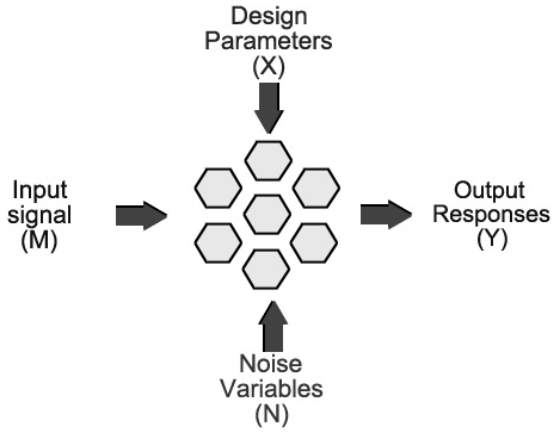


FIGURE 2B: Schematic view of a typical dynamic optimization problem being studied.

Step 1: *Describe Project*	*Describe and develop a system model that identifies system and sub-systems that contain detail elements of the product or process.*
Step 2: *Formulate Problem*	*Formulate problem by defining elements such as inputs, outputs, noise parameters and objectives of the study, etc.,*
Step 3: *Generate Design*	*Select a model and a design that are suitable for the objectives and generate the design for experiment and its worksheet.*
Step 4: *Conduct Experiment*	*Conduct or Simulate the experiment run according to the worksheet and enter experiment results.*
Step 5: *Compute Results*	*Compute the experimental data, calculate statistical results and generate graphical output.*
Step 6: *Analyze Relationship*	*Analyze and interpret statistical and graphical outputs to determine the relative effect and the relative importance of various factors.*
Step 7: *Optimize System*	*Optimize and adjust system sensitivity and performance to meet optimum conditions/objectives.*
Step 8: *Perform verification*	*Verify the repeatability of the optimization results with a confirmation experiment.*

FIGURE 3: The eight steps methodology of the present invention.

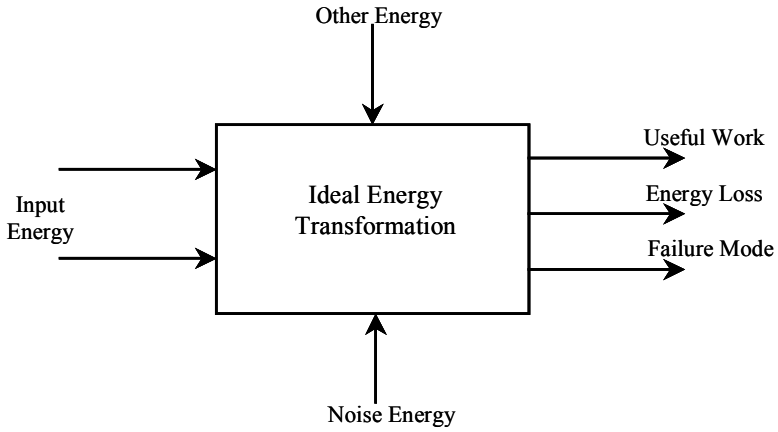


FIGURE 4: The block diagram of the ideal energy function modeling.

Model of Systems/Processes to be Studied (a) To study the design, material and/or the process? (b) Any historical data to study the design, material and/or the process?			
Part/group of systems	**Design**	**Material**	**Process**

FIGURE 5: The function-modeling template for systems/processes studies.

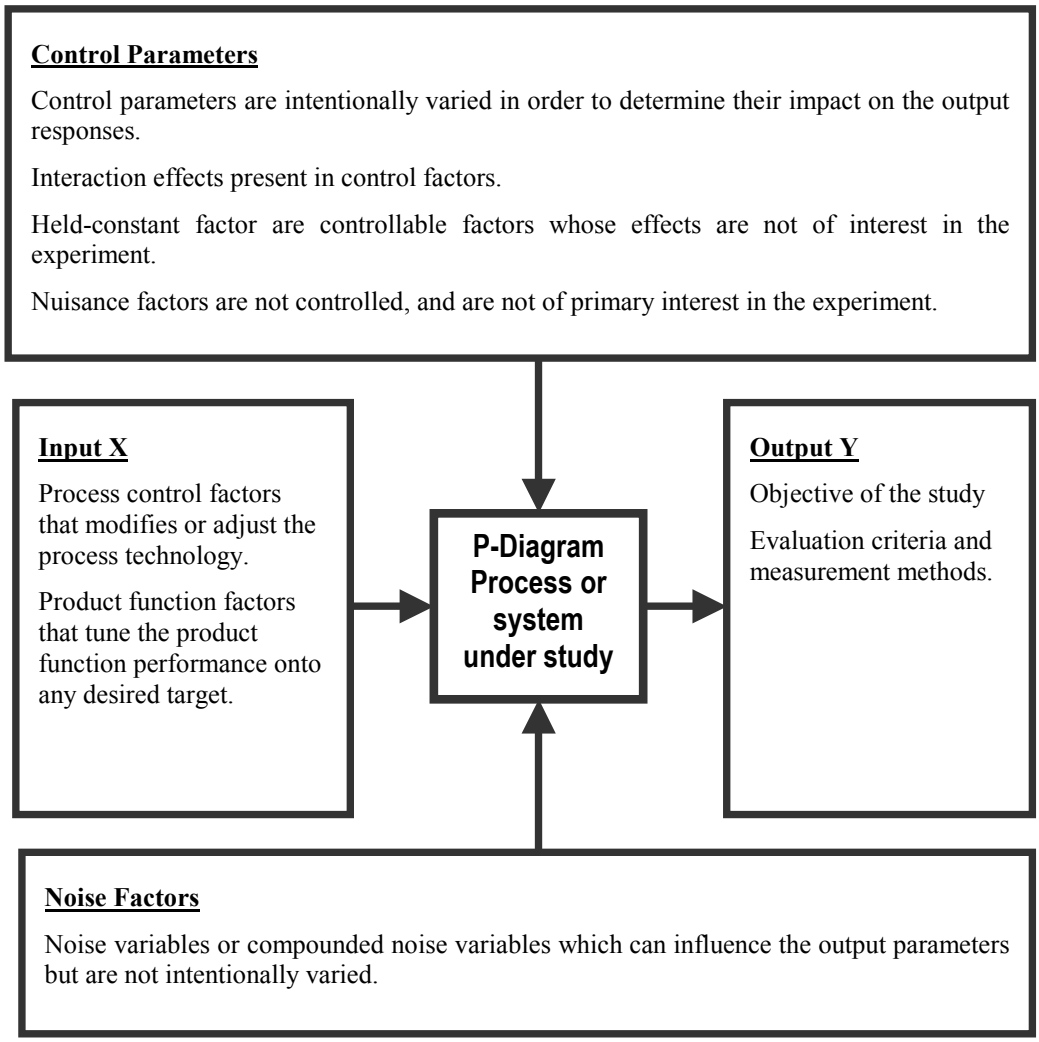


FIGURE 6: Template for formalization of Problem Diagram (P-Diagram).

1. Robust Engineering Project Objectives	
[1] The project objective is to optimize a system, or product or process designs. [2] The project objective is to investigate the effects of individual or multiple parameters on the performance of a particular system. [3] The project objective is to solve robust engineering problems by using statistical design of experiments.	
2. Robust Engineering Investigation Checklist	
[1] What system, product and/or processes are we trying to make and can we do it? [2] What are the critical input parameters and noise variables that affect the system, product and/or processes? [3] Which control parameters are more significant than the others? [4] What is the countermeasure for the attenuation of noise effects caused by unknown factors? [5] How to combine different parameters settings to get the best results and substitute a less expensive part to get the same performance? [6] How to combine multiple criteria of evaluation into a single index? [7] What is the information necessary for adjustment to target value? How can the current status and accuracy be improved? [8] How to search for robustness condition in a system, product and/or processes? [9] How to set up the process such that it is insensitive to noise factors? How the uncontrollable parameters affect the performance? [10] How to improve the system, product and/or processes with good reproducibility? [11] How to perform concurrent research on future and current products? [12] How to retain the knowledge gained in this work for the future and across the company? [13] Which control parameters should have tighter tolerance than others? [14] What need to be done to reduce performance variation around the target?	

FIGURE 7: Checklist and template for robust design project and investigation objectives.

No	Input Parameters - The factors engineer can control and specify to define the optimum combination of set points for satisfying the Voice of the Customer.	Range	Scale Factor	Level

FIGURE 8: Template for assignment of input parameters.

No	Noise Parameters - Any source of variability typically noise is external to the product (such as environmental effects, unit-to-unit variability or effects of deterioration).	Range	Treatment

FIGURE 9: Template for assignment of noise parameters.

No	Output Parameters - Measurement obtained when an experiment is run at each level of the factors under study - continuous (quantitative) variables or discrete (qualitative) variables.	Computational Method	Noise per signal	Replicate per noise

FIGURE 10: Template for output parameters.

Orthogonal Array	Number of Rows	Maximum Number of Factors	Maximum Number of Columns at these Levels				
			2	3	4	5	6
L4	4	3	3	-	-	-	-
L8	8	7	7	-	-	-	-
L8A	8	5	4	-	1	-	-
L9	9	4	-	4	-	-	-
L12	12	11	11	-	-	-	-
L16	16	15	15	-	-	-	-
L16A	16	13	12	-	1	-	-
L16B	16	11	9	-	2	-	-
L16C	16	9	6	-	3	-	-
L16D	16	5	-	-	5	-	-
L18	18	8	1	7	-	-	-
L18A	18	8	2	6	-	-	-
L18B	18	7	-	6	1	-	-
L18C	18	7	-	6	-	1	-
L18D	18	7	-	6	-	-	1
L25	25	6	-	-	-	6	-
L27	27	13	-	13	-	-	-
L27A	27	22	-	22	-	-	-
L32	32	31	31	-	-	-	-
L32A	32	10	1	-	9	-	-
L36	36	23	11	12	-	-	-
L36A	36	16	3	13	-	-	-
L50	50	12	1	-	-	11	-
L54	54	26	1	25	-	-	-
L64	64	63	63	-	-	-	-
L64A	64	21	-	-	21	-	-
L81	81	40	-	40	-	-	-

FIGURE 11: The embedded knowledge-based of the present invention.

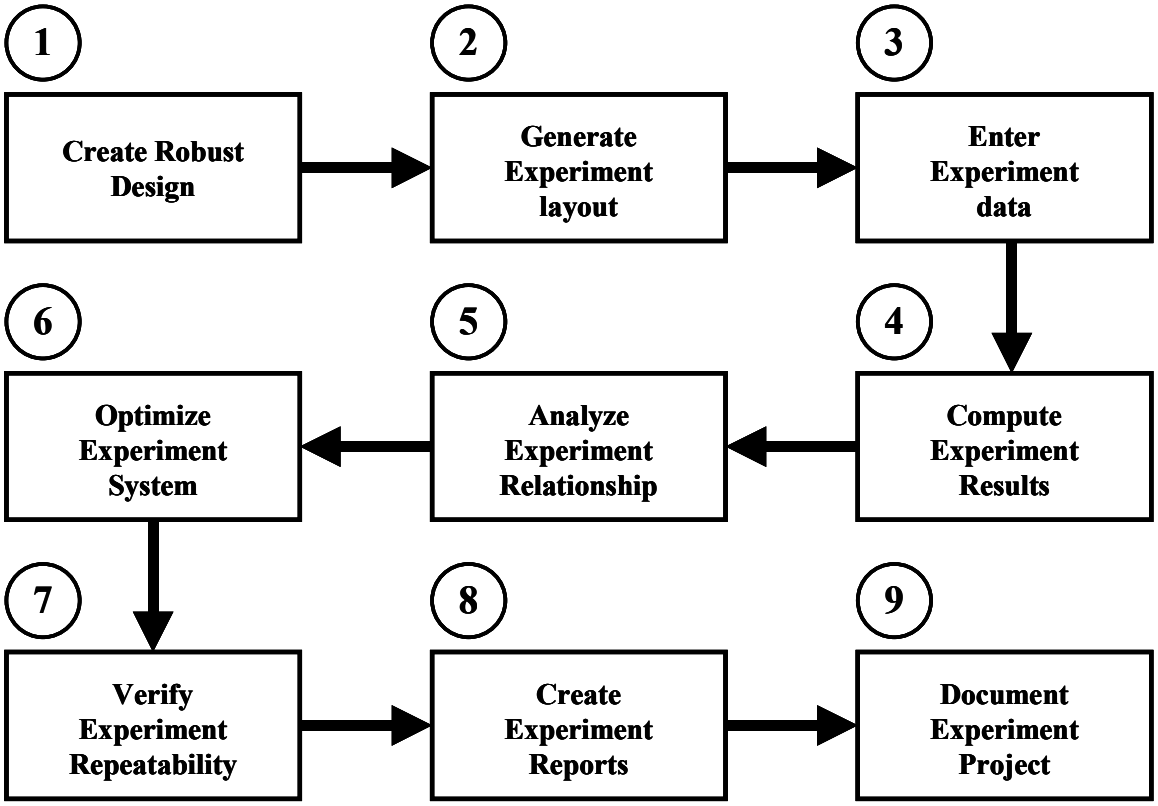


FIGURE 12: Flowchart explaining the flow of entire computerized system according to the eight steps methodology embodiment of the present invention.

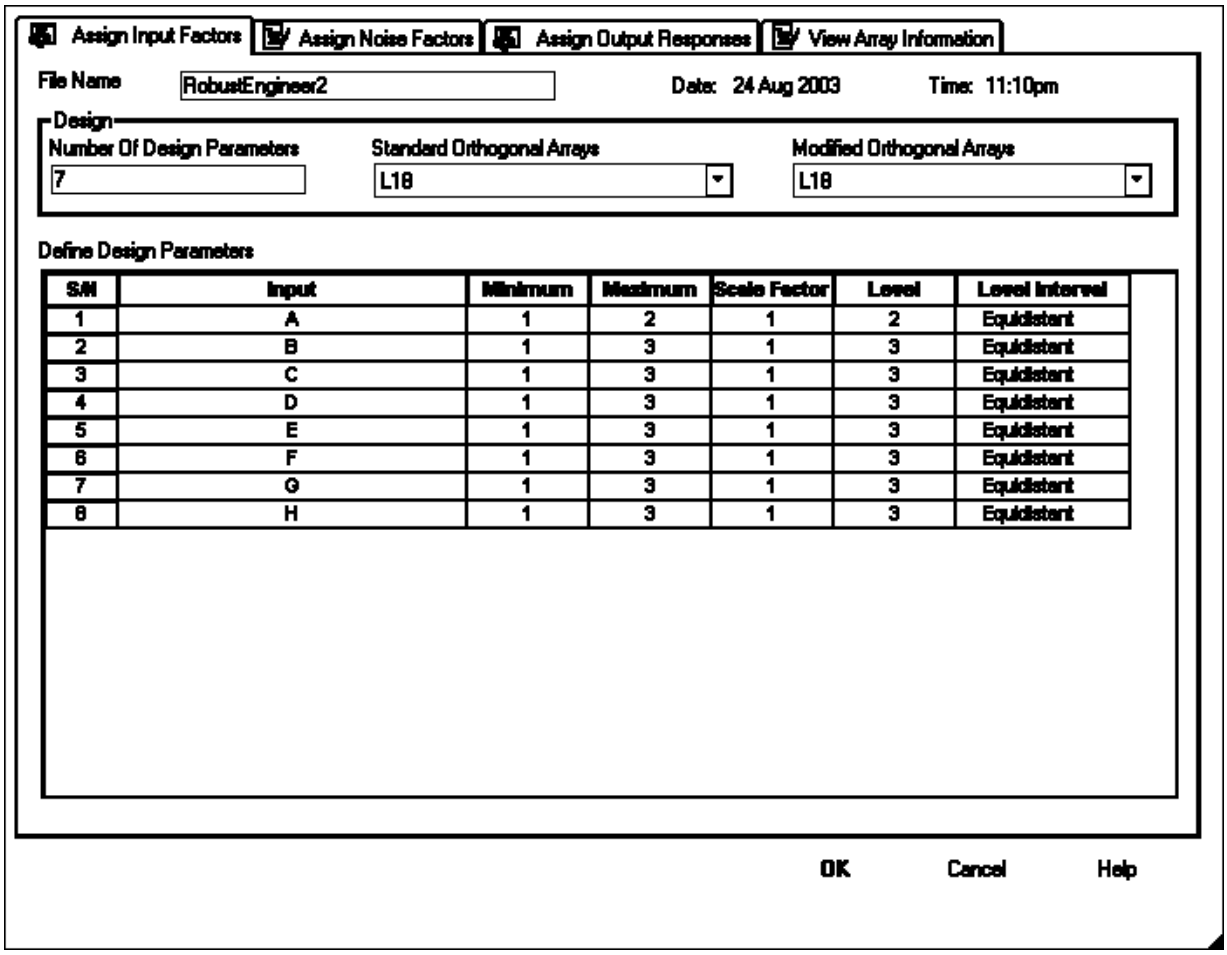


FIGURE 13A: Computerized system for creating robust design – assignment of inner array.

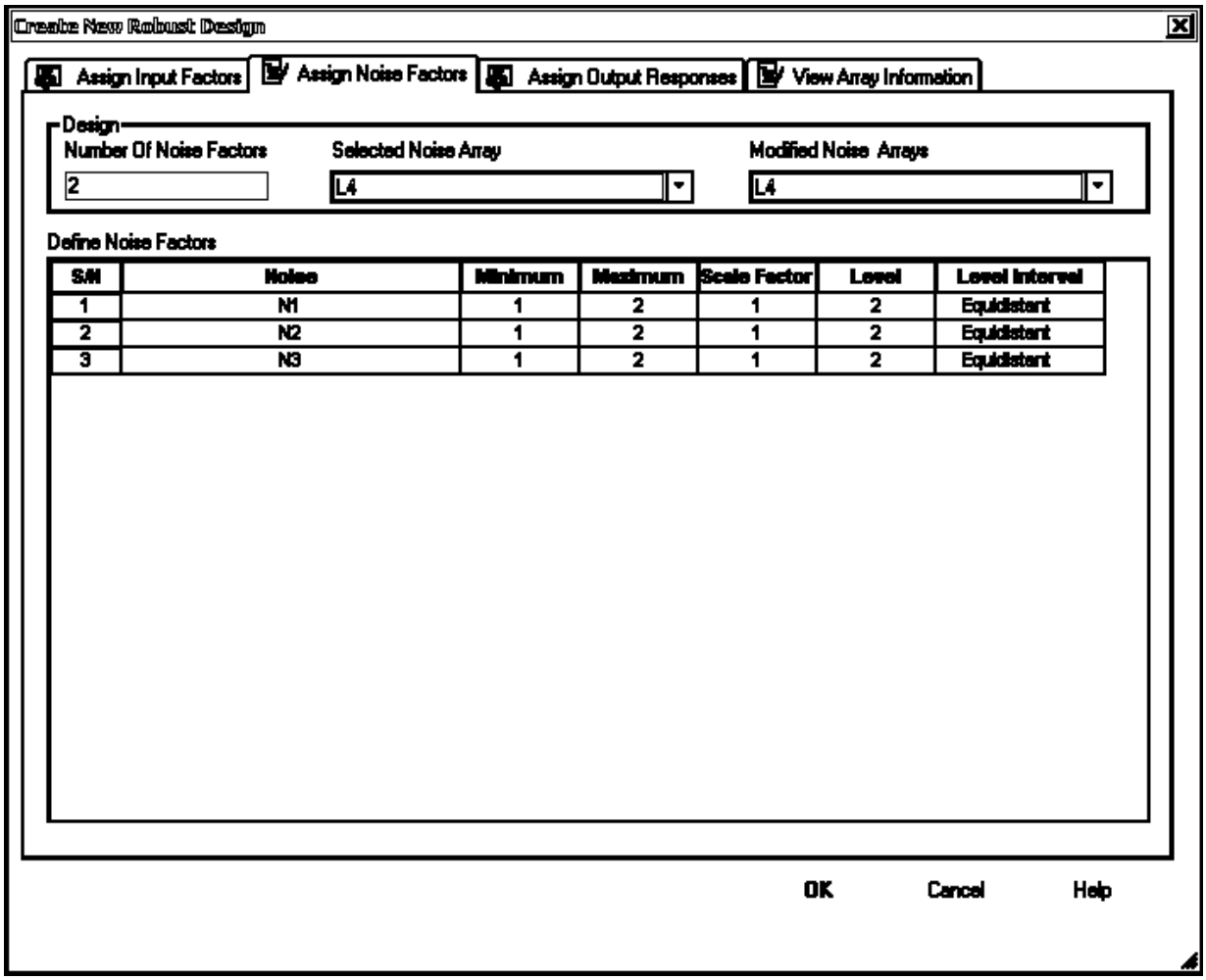


FIGURE 13B: Computerized system for creating robust design – assignment of outer array.

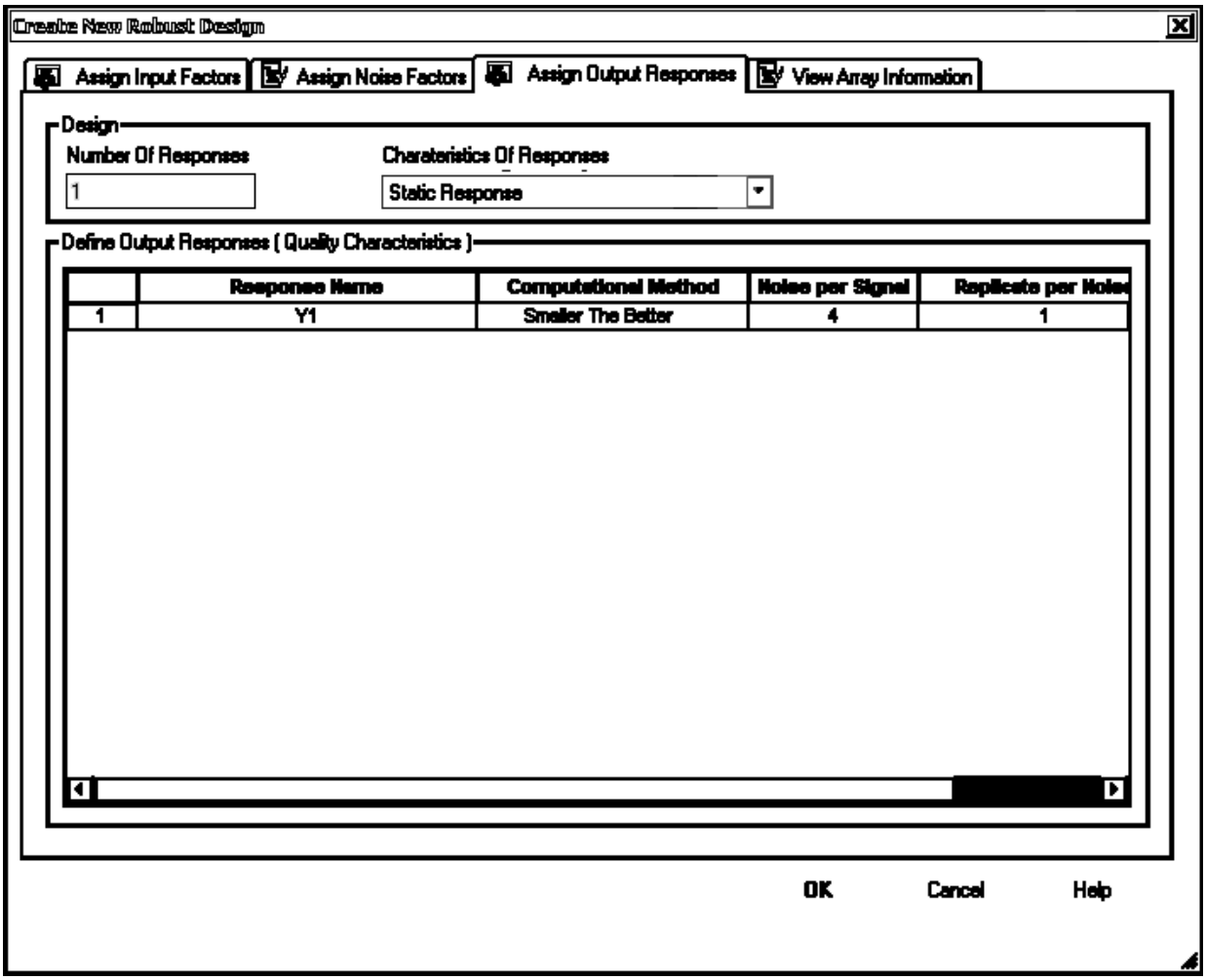
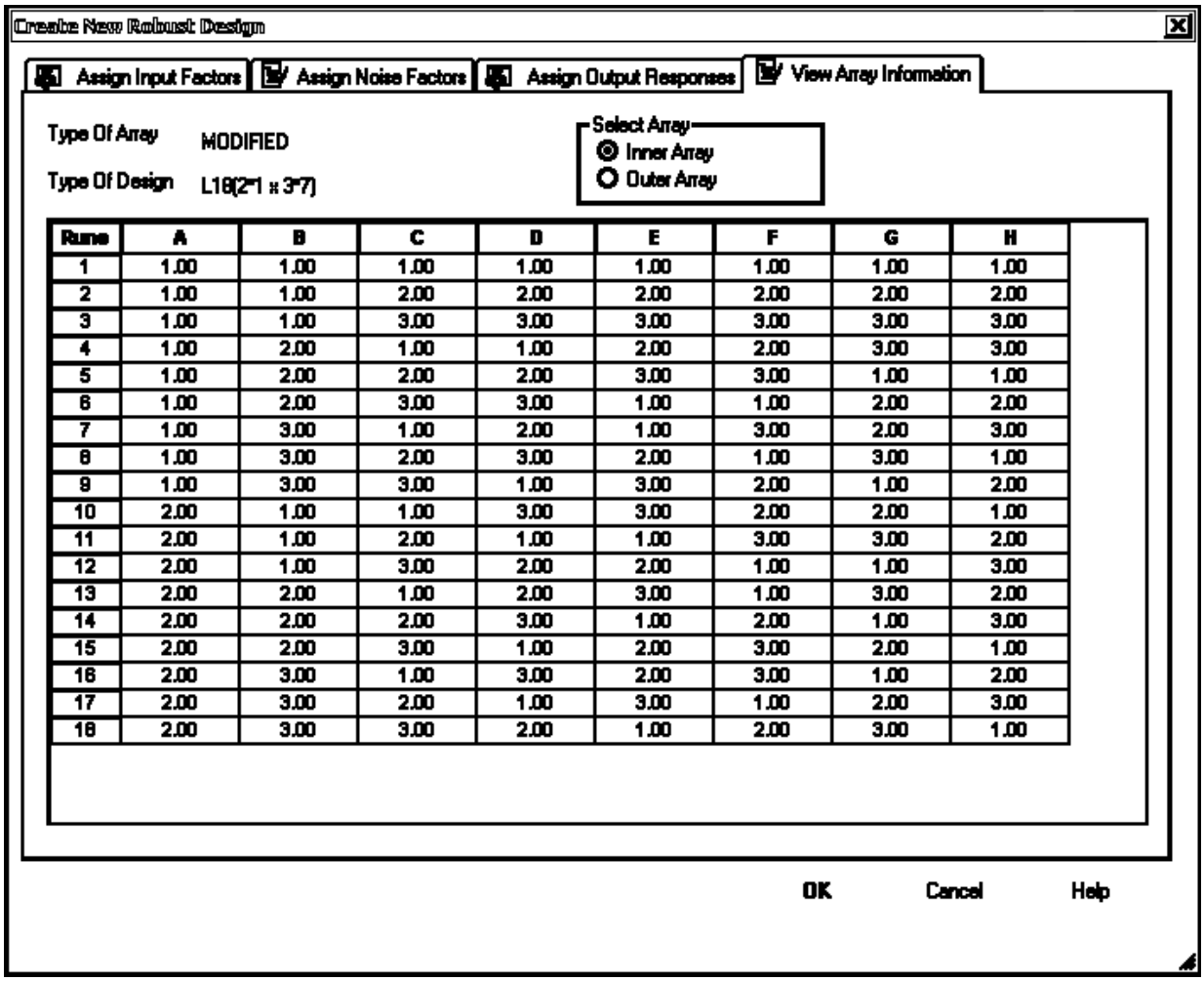


FIGURE 13C: Computerized system for creating robust design – assignment of output responses.



Runs	A	B	C	D	E	F	G	H
1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00
3	1.00	1.00	3.00	3.00	3.00	3.00	3.00	3.00
4	1.00	2.00	1.00	1.00	2.00	2.00	3.00	3.00
5	1.00	2.00	2.00	2.00	3.00	3.00	1.00	1.00
6	1.00	2.00	3.00	3.00	1.00	1.00	2.00	2.00
7	1.00	3.00	1.00	2.00	1.00	3.00	2.00	3.00
8	1.00	3.00	2.00	3.00	2.00	1.00	3.00	1.00
9	1.00	3.00	3.00	1.00	3.00	2.00	1.00	2.00
10	2.00	1.00	1.00	3.00	3.00	2.00	2.00	1.00
11	2.00	1.00	2.00	1.00	1.00	3.00	3.00	2.00
12	2.00	1.00	3.00	2.00	2.00	1.00	1.00	3.00
13	2.00	2.00	1.00	2.00	3.00	1.00	3.00	2.00
14	2.00	2.00	2.00	3.00	1.00	2.00	1.00	3.00
15	2.00	2.00	3.00	1.00	2.00	3.00	2.00	1.00
16	2.00	3.00	1.00	3.00	2.00	3.00	1.00	2.00
17	2.00	3.00	2.00	1.00	3.00	1.00	2.00	3.00
18	2.00	3.00	3.00	2.00	1.00	2.00	3.00	1.00

FIGURE 13D: Computerized system for creating robust design – display of inner and outer arrays.

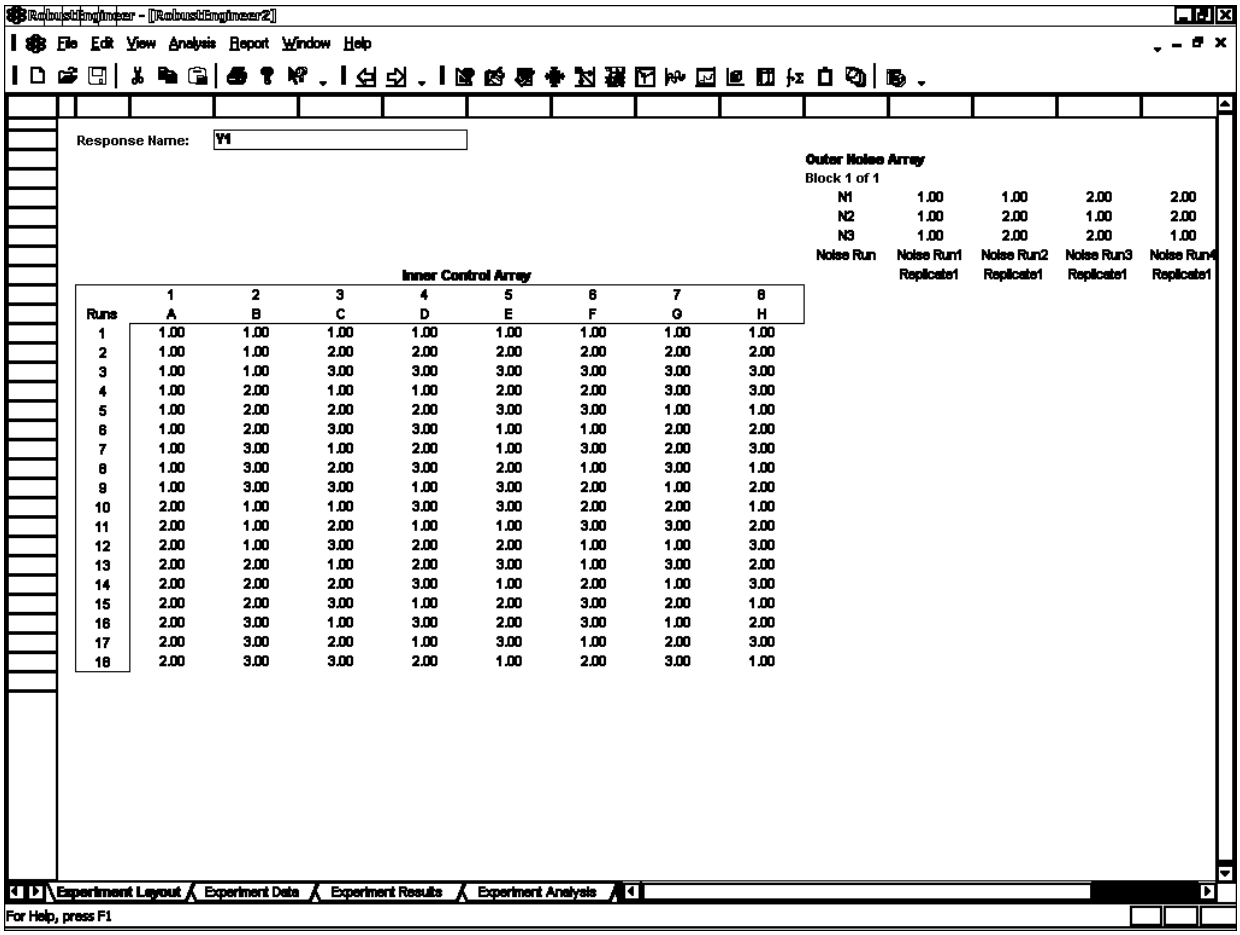


FIGURE 14: Computerized system for displaying robust experiment design layout worksheet (inner and outer array).

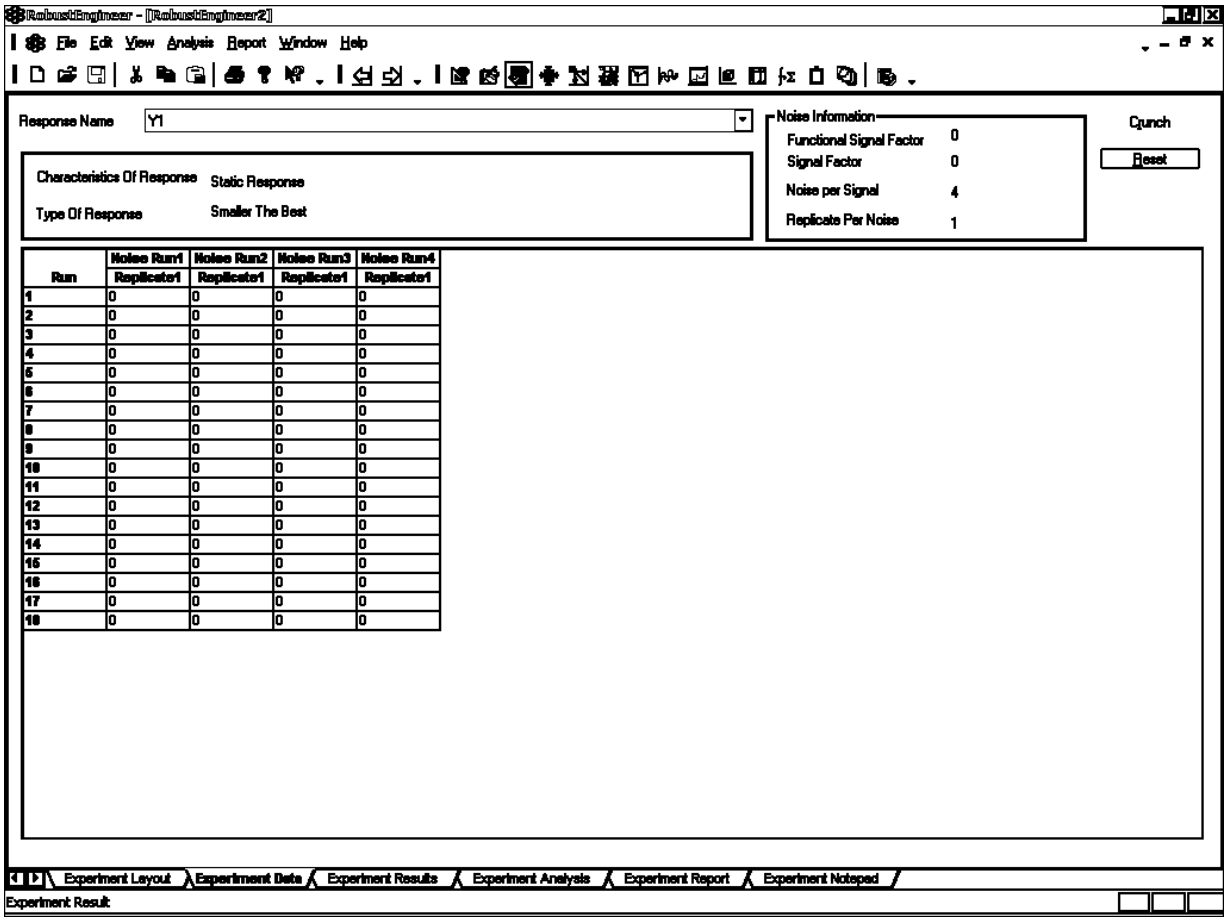


FIGURE 15: Computerized system for data entry of the performance measurement data.

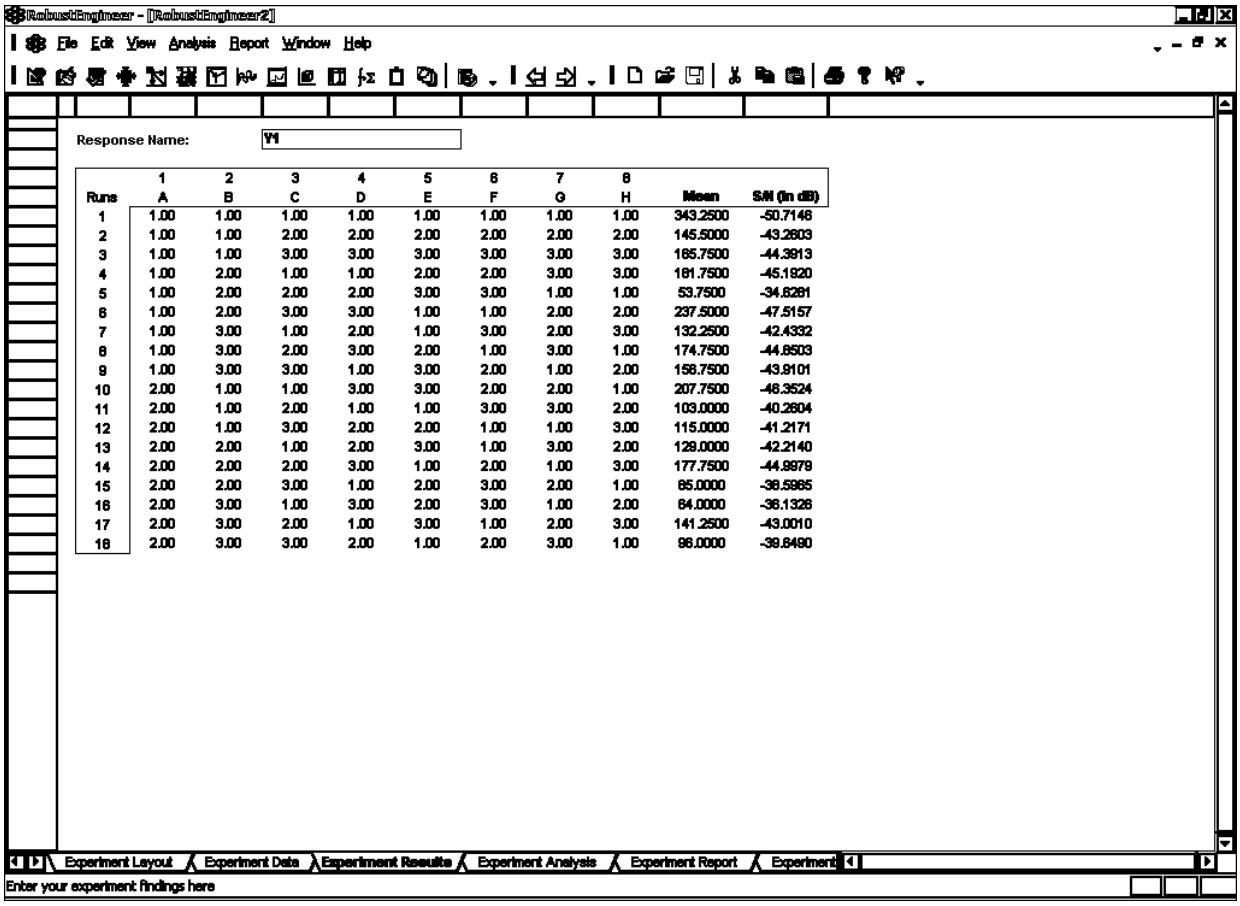


FIGURE 16: Exemplifies an example of a computerized screen for computing the experiment results using analysis of mean.

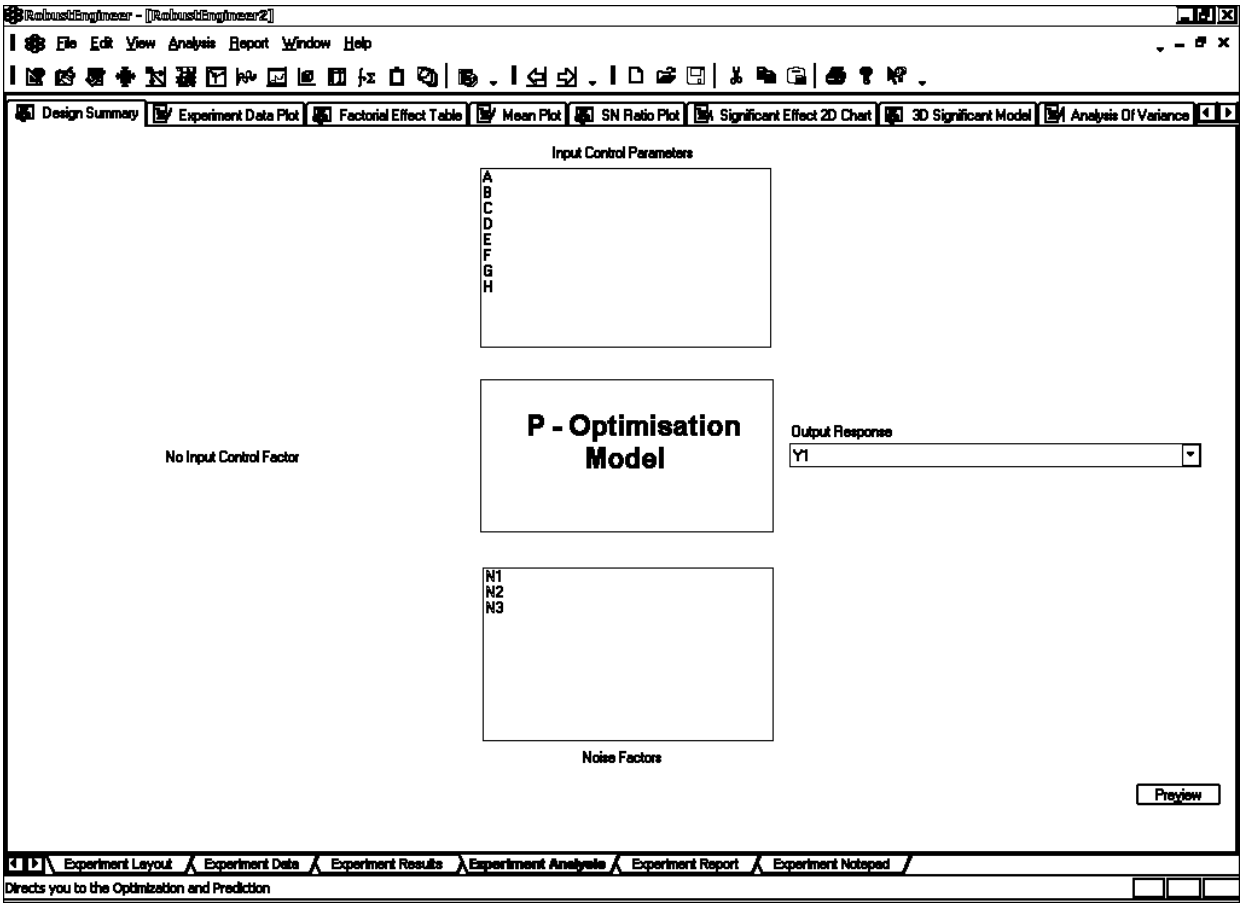


FIGURE 17A: Computerized screen of a Problem-Diagram for performing experiment analysis.

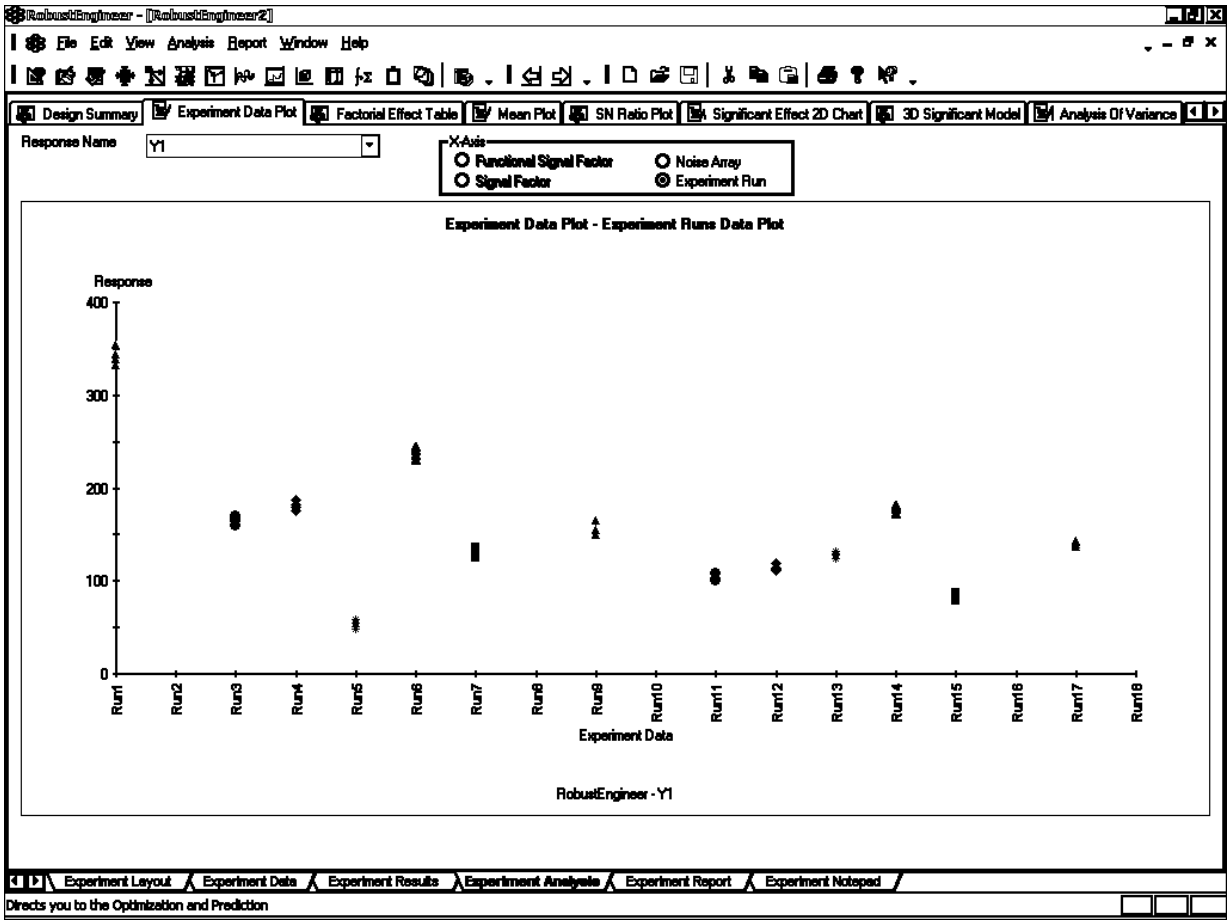
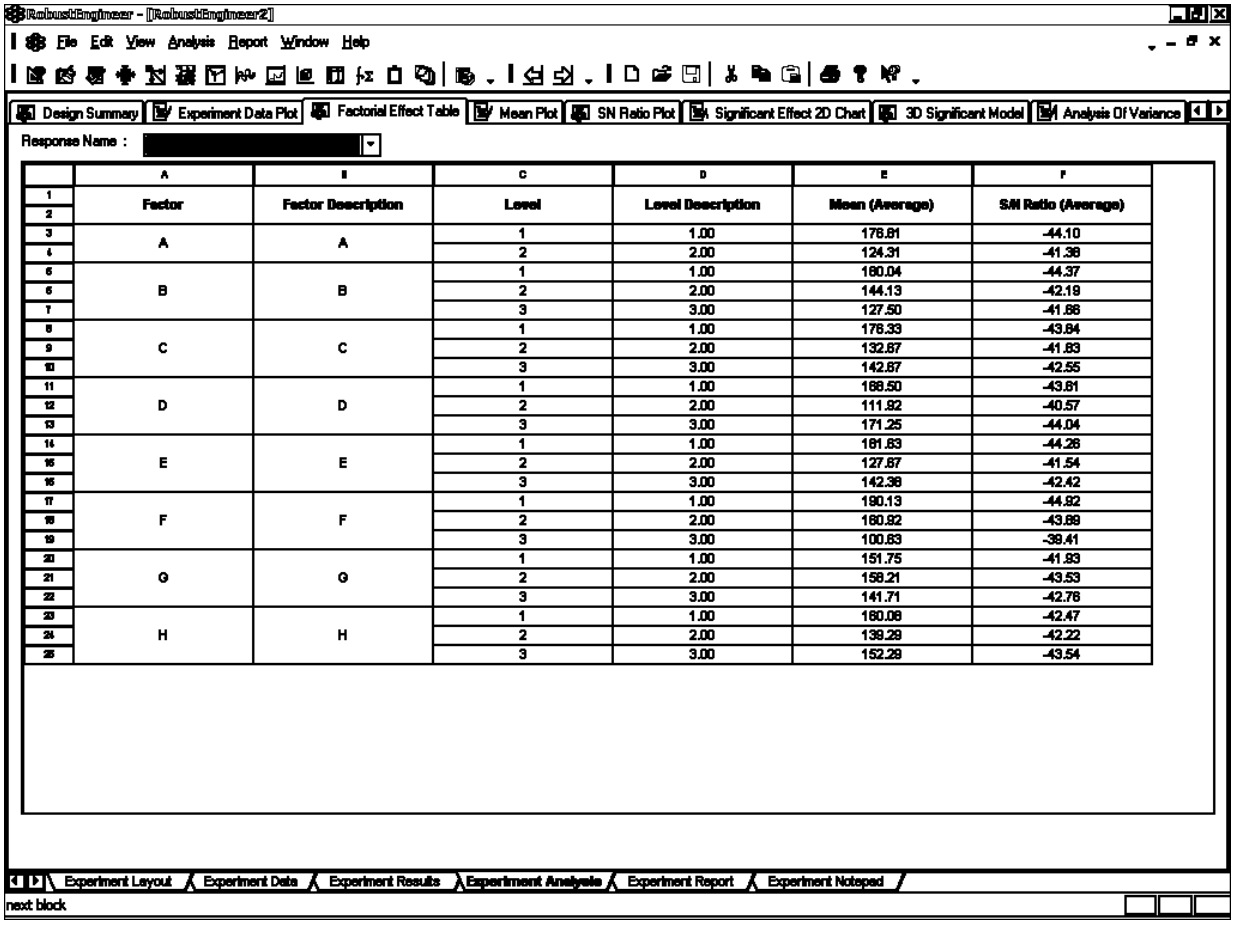


FIGURE 17B: Computerized screen of a data plot for performing experiment analysis.



	A	B	C	D	E	F
1						
2	Factor	Factor Description	Level	Level Description	Mean (Average)	S/N Ratio (Average)
3	A	A	1	1.00	176.81	-44.10
4			2	2.00	124.31	-41.39
5	B	B	1	1.00	180.04	-44.37
6			2	2.00	144.13	-42.19
7			3	3.00	127.50	-41.86
8	C	C	1	1.00	176.33	-43.84
9			2	2.00	132.67	-41.83
10			3	3.00	142.67	-42.55
11	D	D	1	1.00	166.50	-43.61
12			2	2.00	111.92	-40.57
13			3	3.00	171.25	-44.04
14	E	E	1	1.00	161.83	-44.26
15			2	2.00	127.67	-41.54
16			3	3.00	142.38	-42.42
17	F	F	1	1.00	180.13	-44.92
18			2	2.00	160.92	-43.89
19			3	3.00	100.83	-39.41
20	G	G	1	1.00	151.75	-41.93
21			2	2.00	158.21	-43.53
22			3	3.00	141.71	-42.76
23	H	H	1	1.00	160.08	-42.47
24			2	2.00	139.29	-42.22
25			3	3.00	152.29	-43.54

FIGURE 17C: Computerized screen of a factorial effect table for performing experiment analysis.

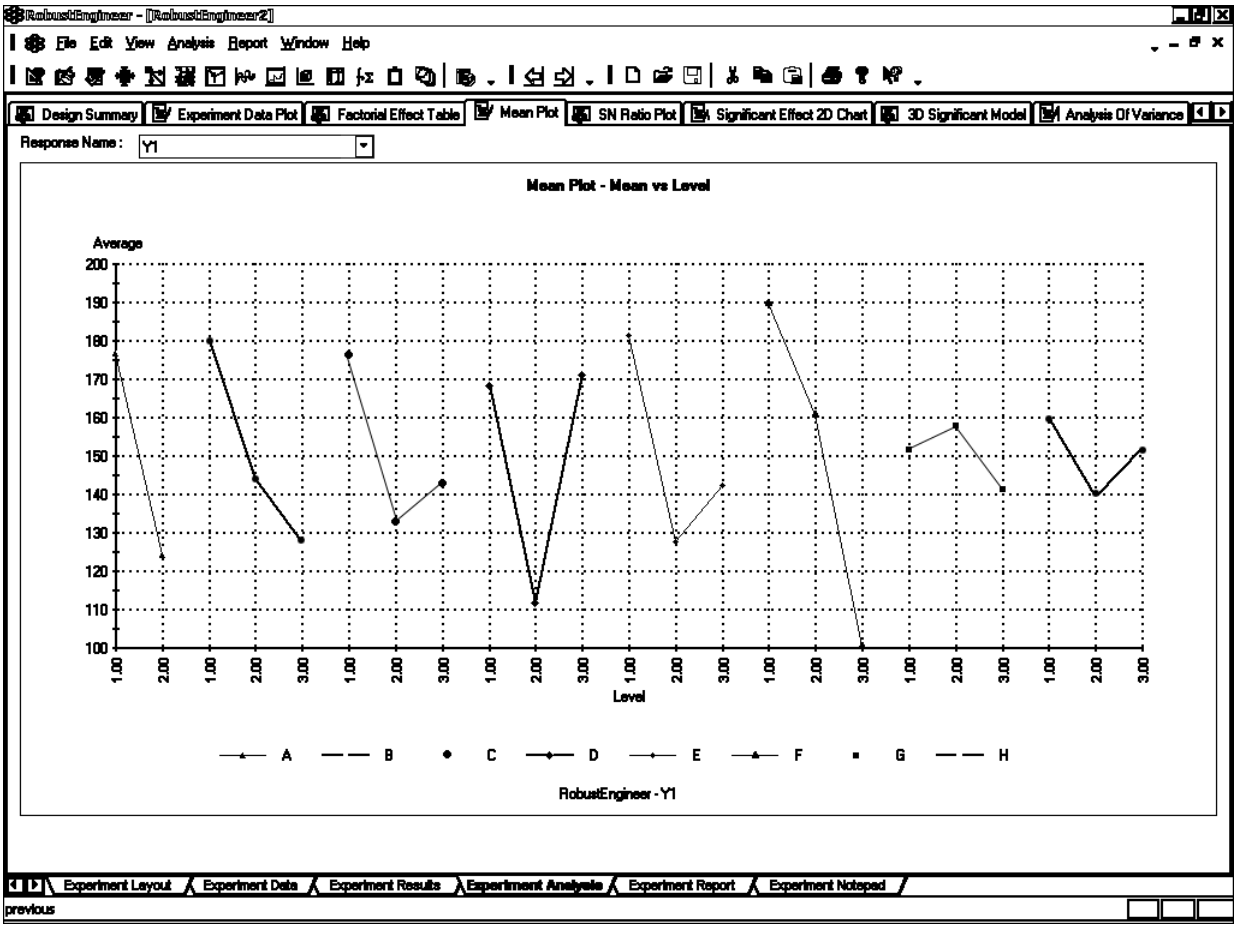


FIGURE 17D: Computerized screen of a graphical technique for displaying 2-Dimemsional mean effects and interaction plots.

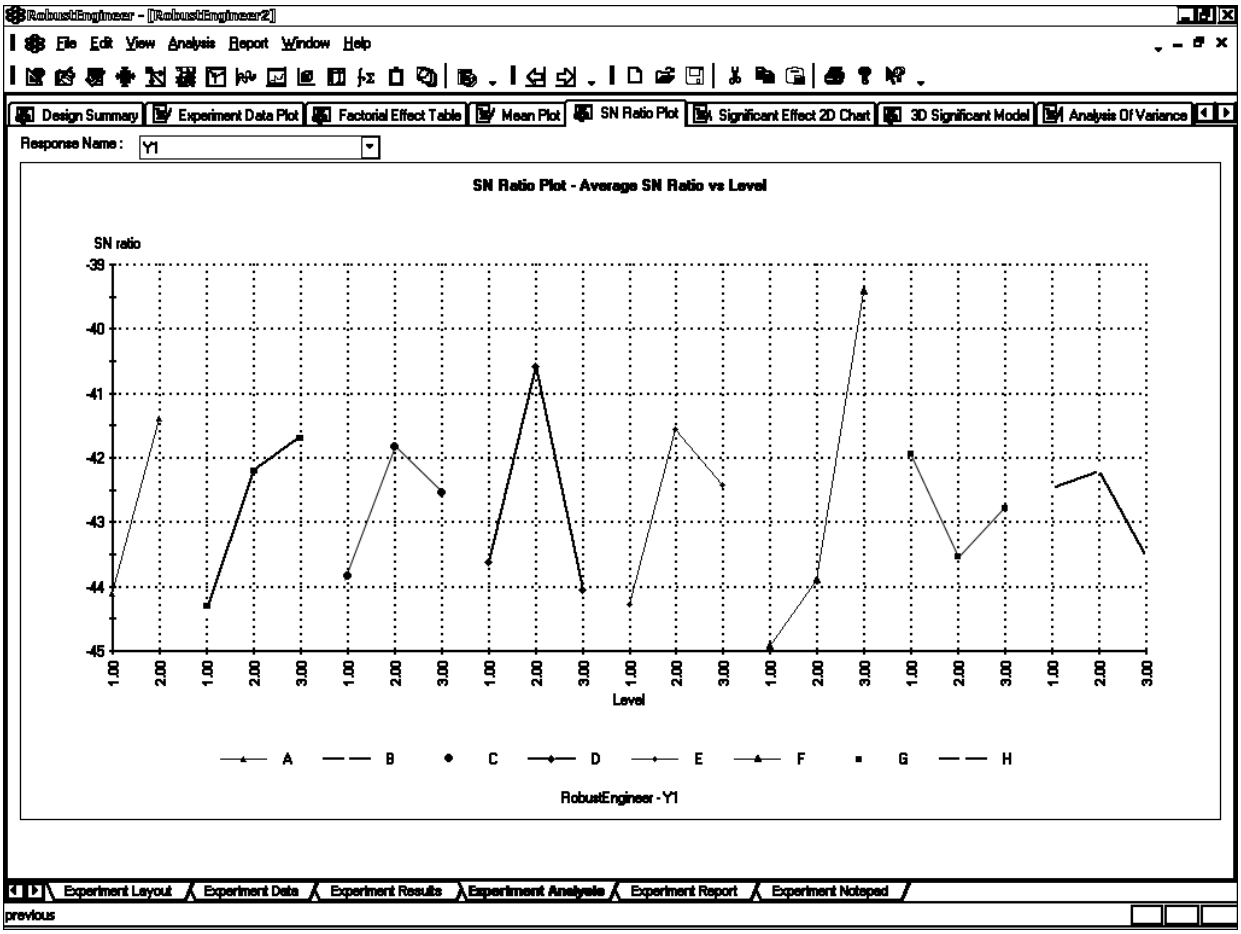


FIGURE 17E: Computerized screen of a graphical technique for displaying 2-Dimemsional Signal-to-Noise ratio effects and interaction plots.

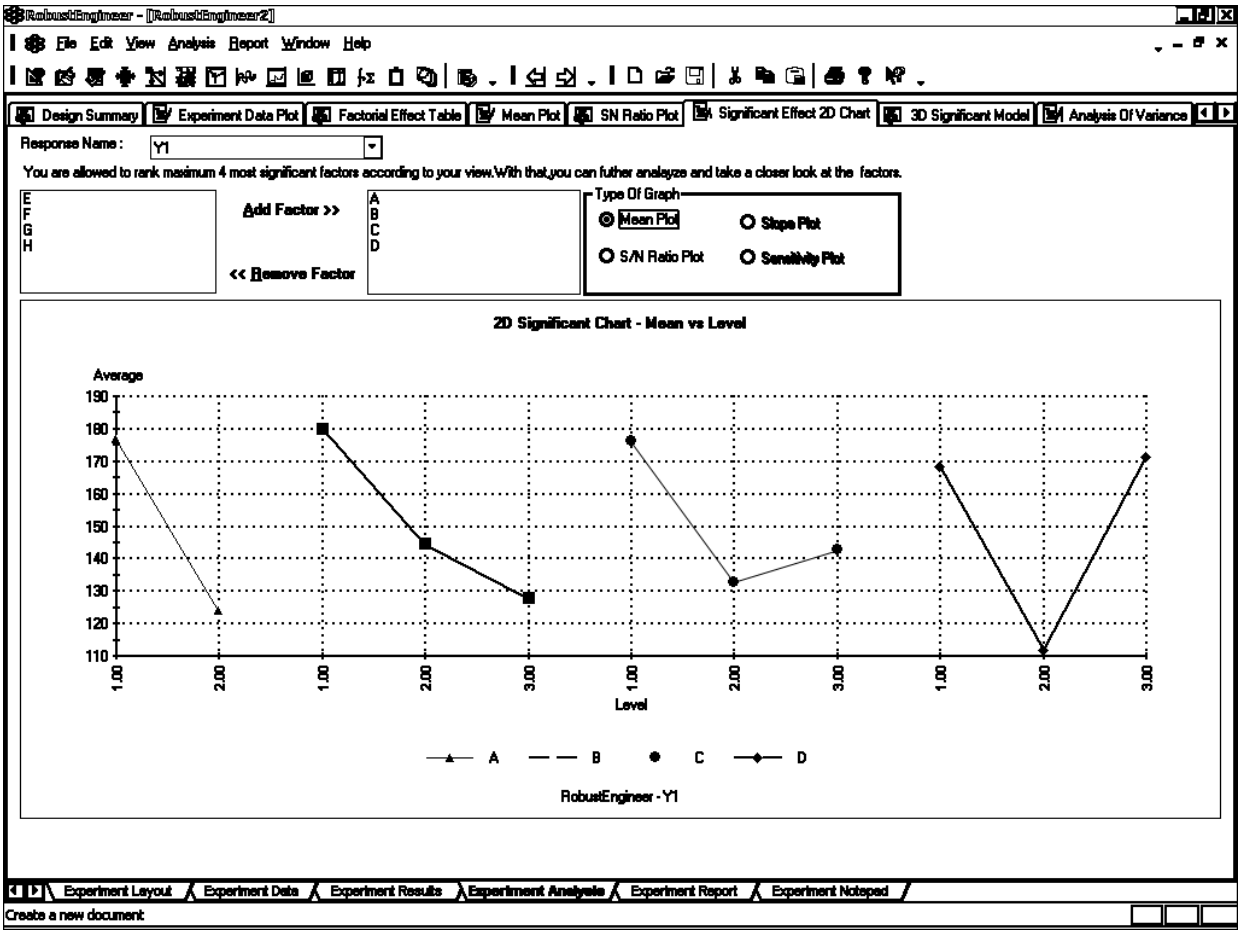


FIGURE 17F: Computerized screen of a graphical technique for displaying a significant mean effect and interaction 2-Dimemsional plots.

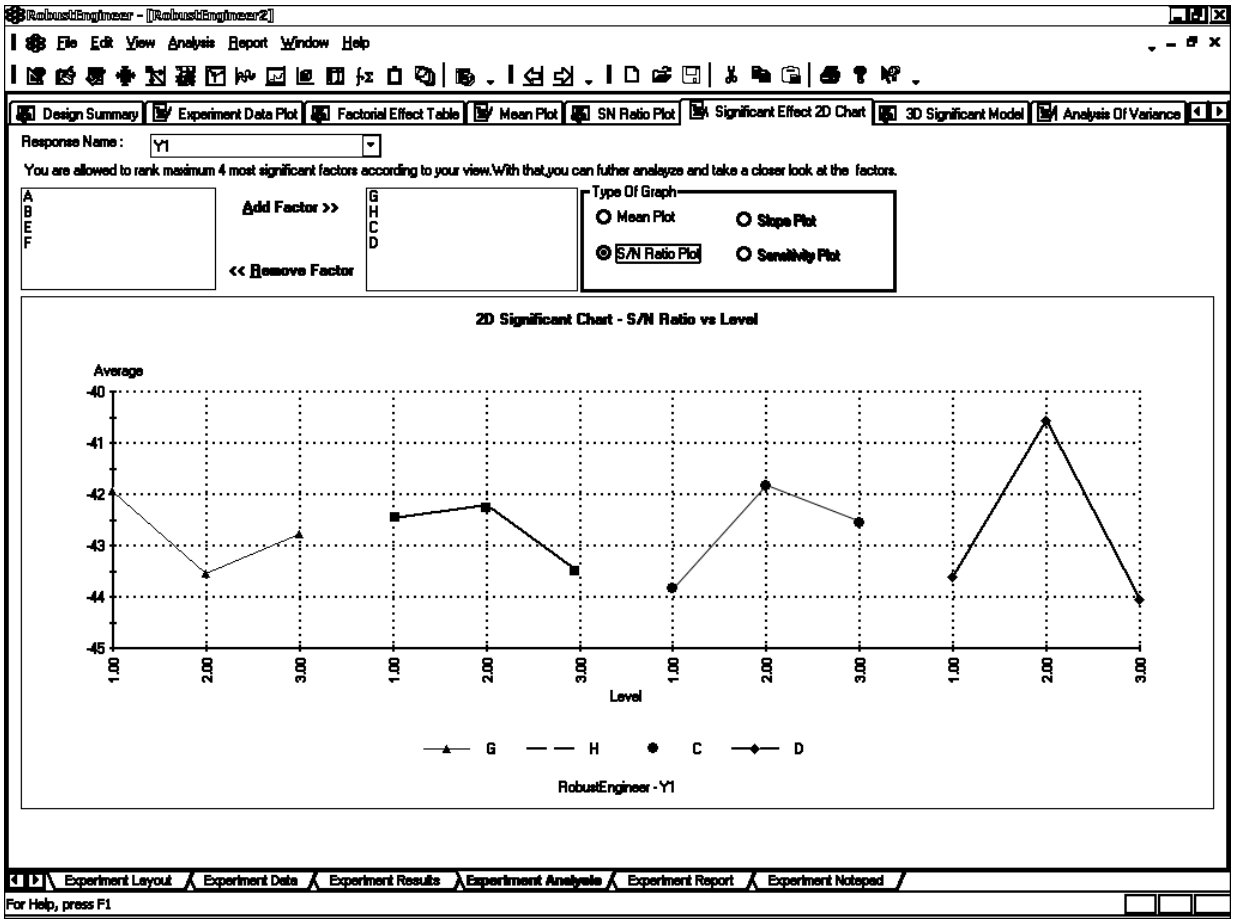


FIGURE 17G: Computerized screen of a graphical technique for displaying a significant Signal-to-Noise ratio effect and interaction 2-Dimemsional plots.

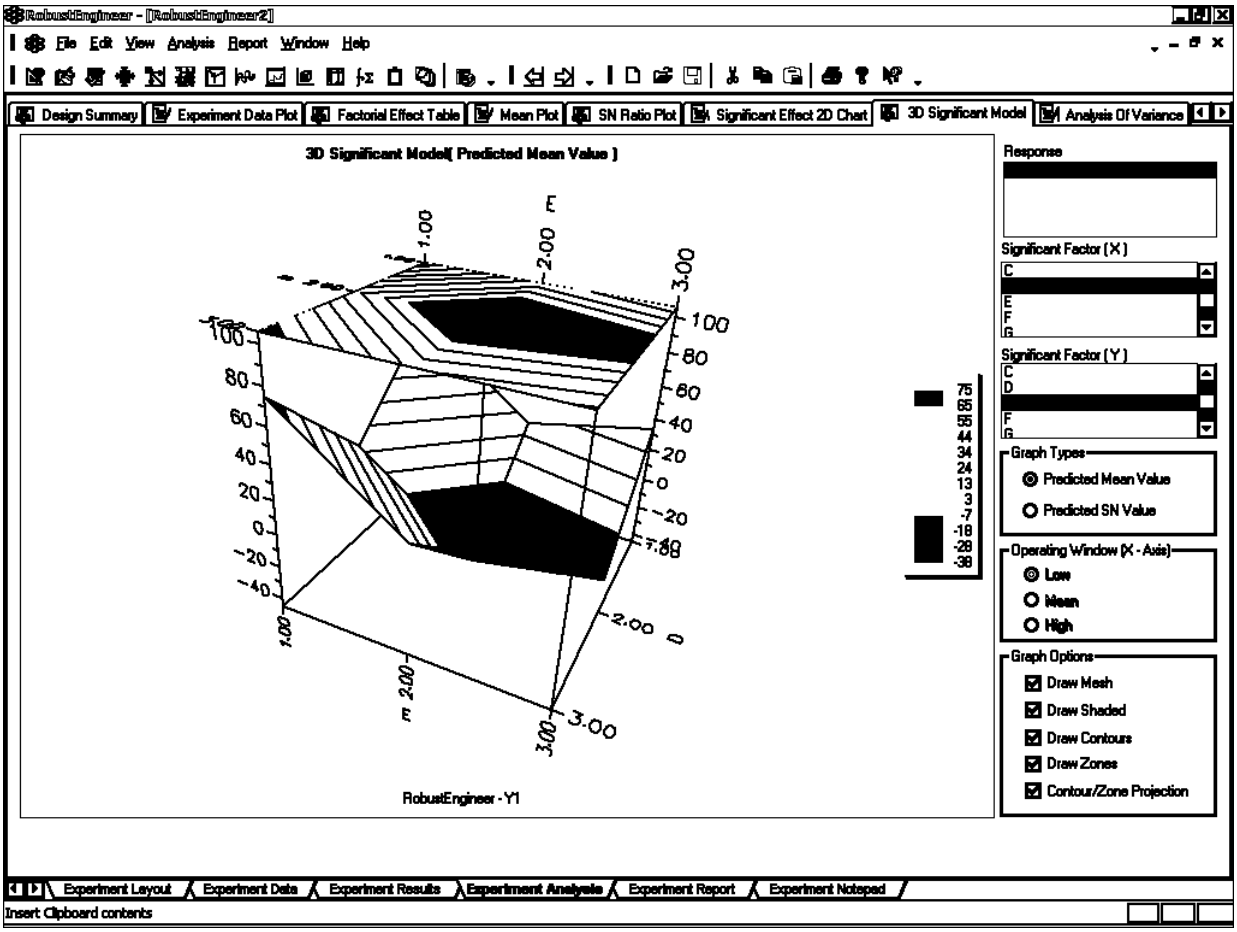


FIGURE 17H: Computerized screen of a graphical technique for displaying a 3-Dimemsional surfaces and contour plots to help interpret results.

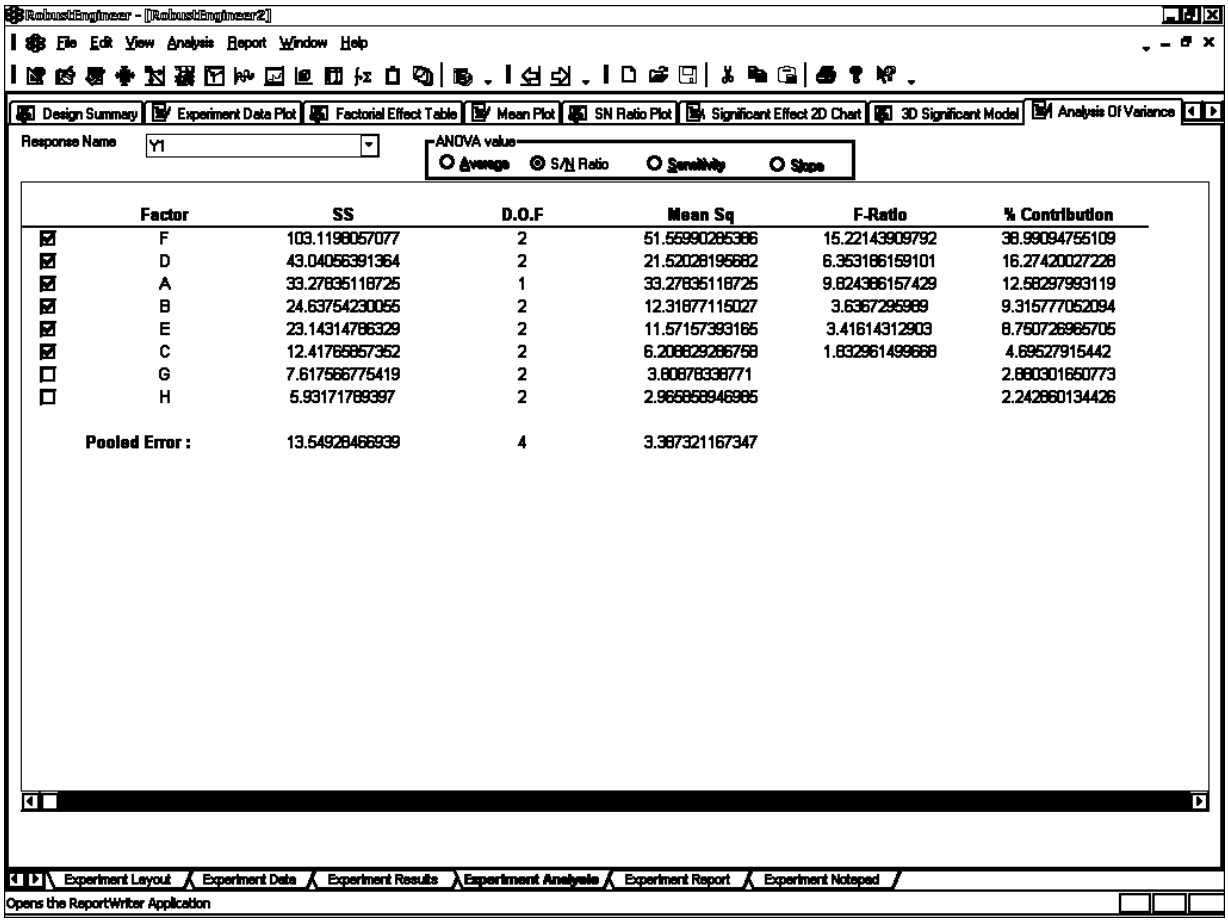


FIGURE 17I: Computerized screen of an Analysis of Variance (ANOVA) for performing experiment analysis.

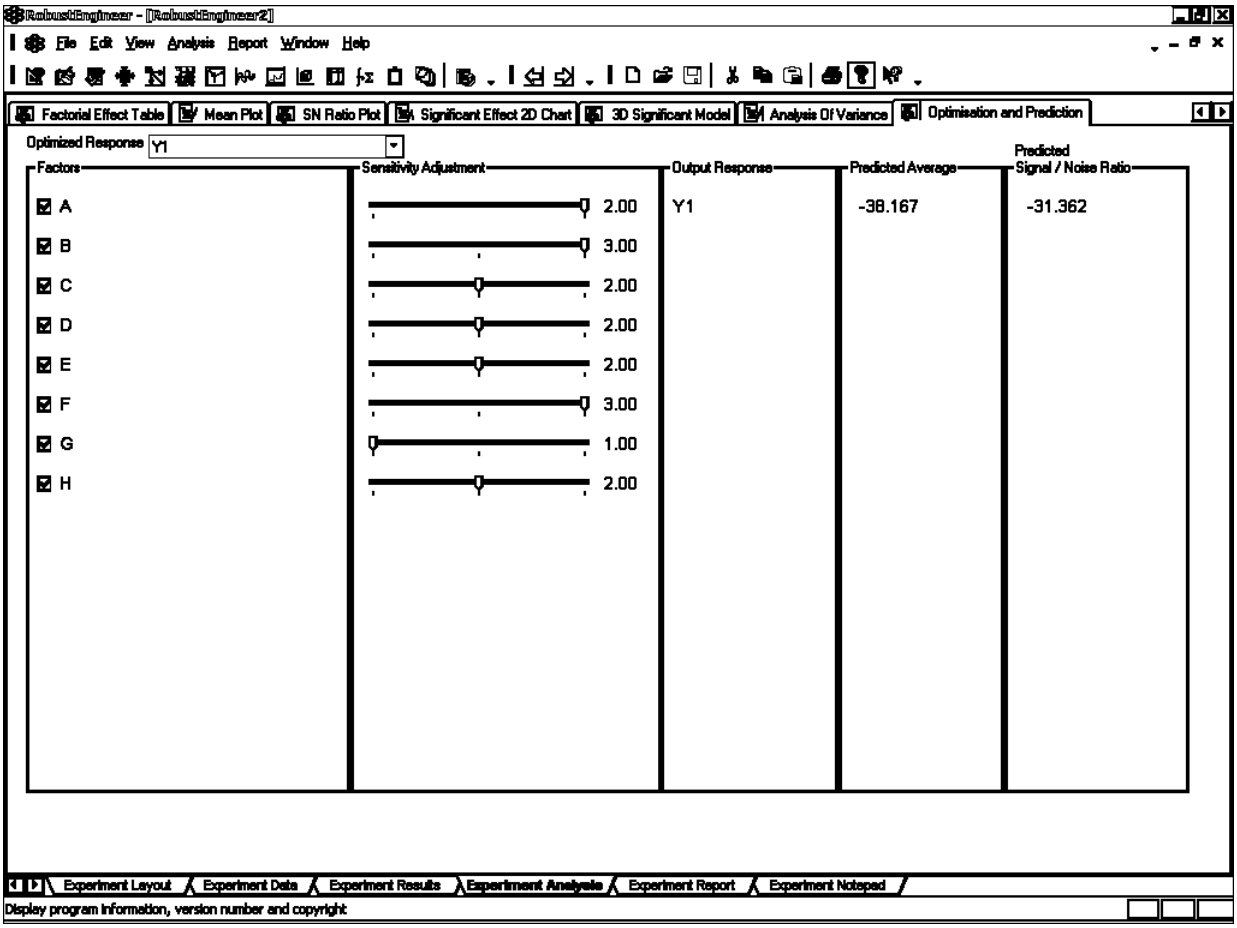


FIGURE 17J: Computerized screen for sensitivity analysis as well as optimization of decisions with suggested optimal settings.

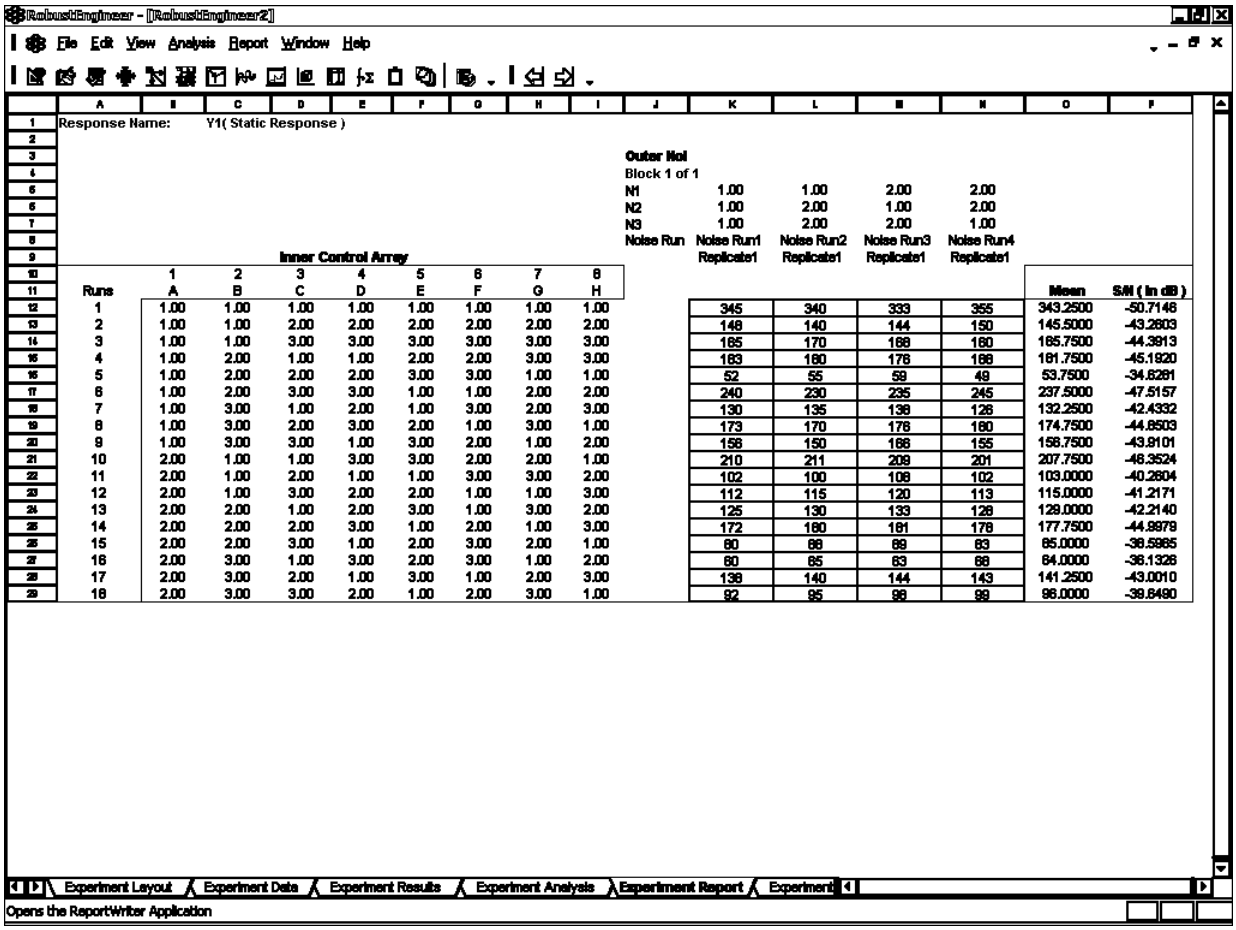


FIGURE 18: Computerized screen for printing experimental results.

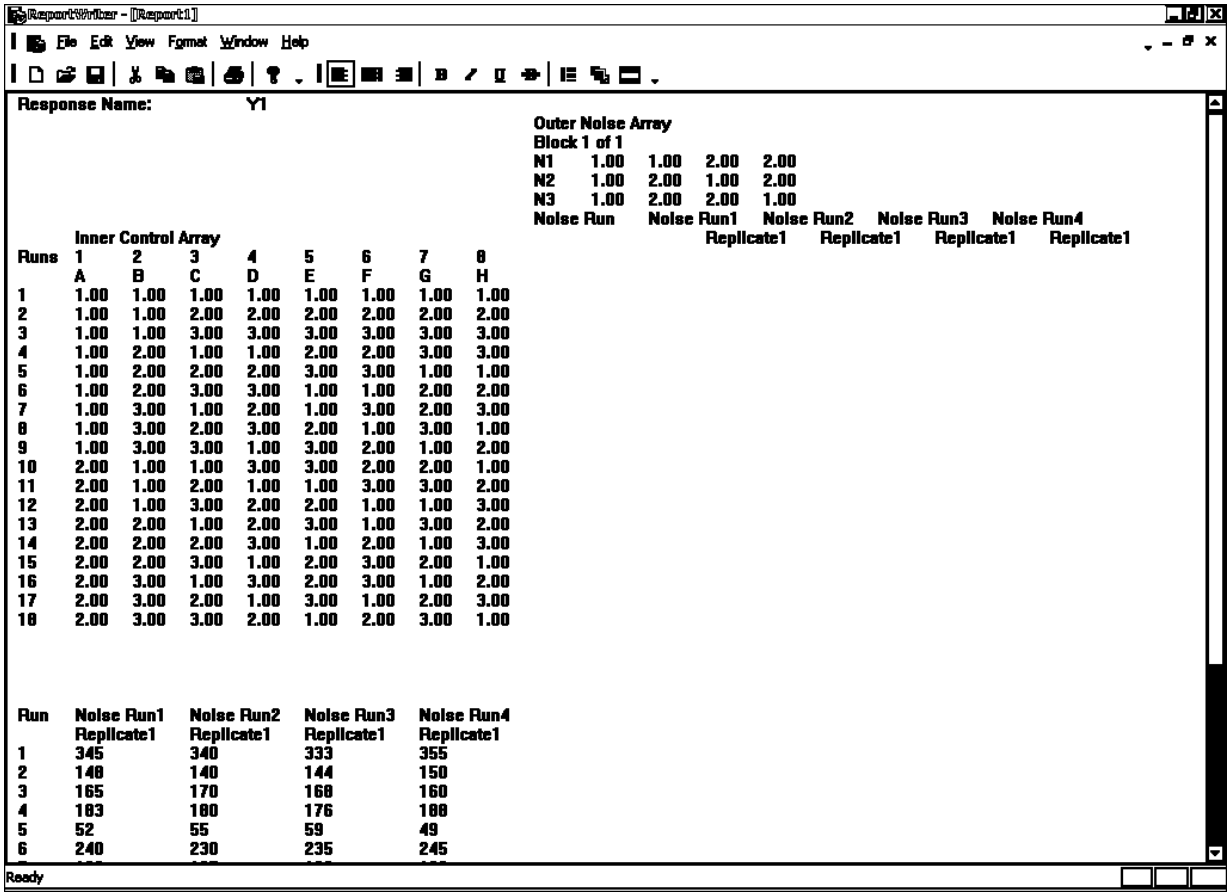


FIGURE 19: Computerized screen of a report writer for quick experimentation documentation storage and archival.

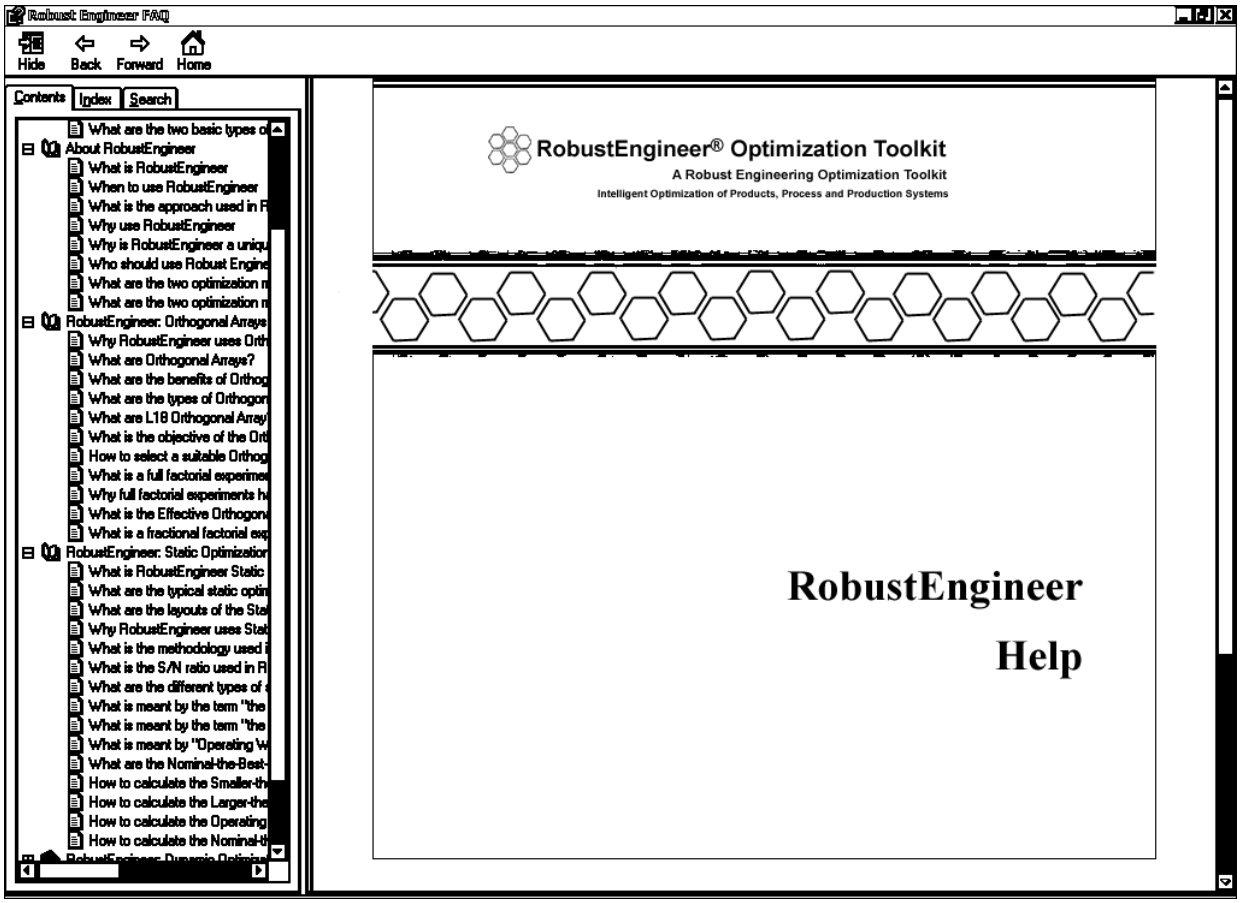


FIGURE 20: Computerized screen for quick online help function and documentation.