Expert COSYSMO

Ray Madachy, Ricardo Valerdi
USC Center for Systems and Software Engineering
MIT Lean Aerospace Initiative
madachy@usc.edu, rvalerdi@mit.edu

Abstract
Expert COSYSMO is an expert system tool for systems engineering risk assessment based on the Constructive Systems Engineering Cost Model (COSYSMO). It has been developed with collaboration between USC CSSE, its industrial affiliates and MIT. The technique is an extension of COSYSMO which supports project planning by identifying, categorizing, quantifying, and prioritizing system-level risks. A survey was used to identify and quantify risks, and the expert assessment has been implemented in an Internet-based tool. The tool is being refined for sustained usage on projects by providing risk control advice, updating the rule base and being integrated into a more comprehensive risk management framework.

Method
Approaches for identifying systems engineering risks are usually separate from cost estimation. The automated technique identifies risks in conjunction with cost estimation, as it analyzes patterns of cost driver ratings submitted for a COSYSMO cost estimate. It identifies individual risks that an experienced systems engineering manager might recognize but often fails to take into account. This information helps users determine and rank associated sources of project risk. With these risks, mitigation plans can be created based on the relative risk severities and provided advice.

Predetermined combinations of driver ratings provide red flags of possible risks as the project progresses along its life cycle. For example, if the architecture understanding cost driver is rated "Very Low" and the technology maturity is also "Very Low" then this indicates a potential risk in the project given that systems with immature technologies are more difficult to implement especially when the architecture is not well understood. These scenarios are predetermined and configured into the model as a set of rules that can automate and improve the risk management process.

Figure 1 shows these risk conditions identified from the survey and implemented in the model. Figure 2 presents sample outputs of Expert COSYSMO with un-scaled risks.

Current and Future Work
The risk levels are being calibrated for usage, and we are making the outputs more actionable so that explicit risk management steps can be undertaken by users. Specific tasks to be completed before the Forum include:

- Scaling the risk summary outputs for each category and defining ranges for low, medium and high risks
- Adding more explanation to the summary outputs to rationalize the risk quantities
- Documenting expert risk mitigation advice for each risk condition, and providing that automated guidance to users to help develop their own mitigation actions.

	SIZE	RQMT	ARCH	LSVC	MIGR	TRSK	DOCU	INST	RECU	TEAM	PCAP	PEXP	PROC	SITE	TOOL
SIZE (REQ + INTF + ALG + OPSC)		21	21	9	12	5	4	7	10	8	9	11	7	6	7
Requirements Understanding			17	9	7	8	3	5	9	5	10	8	5	4	1
Architecture Understanding				9	10	12	3	7	11	6	11	11	5	6	4
Level of Service Requirements (the ilities)					5	7	4	5	3	6	4	4	2	3	2
Migration Complexity (legacy system considerations)						8	1	10	1	4	7	7	3	5	4
Technology Risk (maturity of technology)							2	8	6	4	9	5	3	3	5
Documentation match to life cycle needs								2	3	4	4	2	6	2	3
Number and Diversity of Installations or Platforms									4	3	5	6	4	8	5
Number of Recursive Levels in the Design										4	8	7	7	2	5
Stakeholder Team Cohesion											7	9	3	8	3
Personnel/team capability												12	9	8	5
Personnel Experience and Continuity													10	8	3
Process Capability														5	8
Multisite Coordination															8
Tool Support															

high risk
medium risk
low risk

small x = 0.5; big X = 1
n = 19

Figure 1: Risk Conditions from Survey

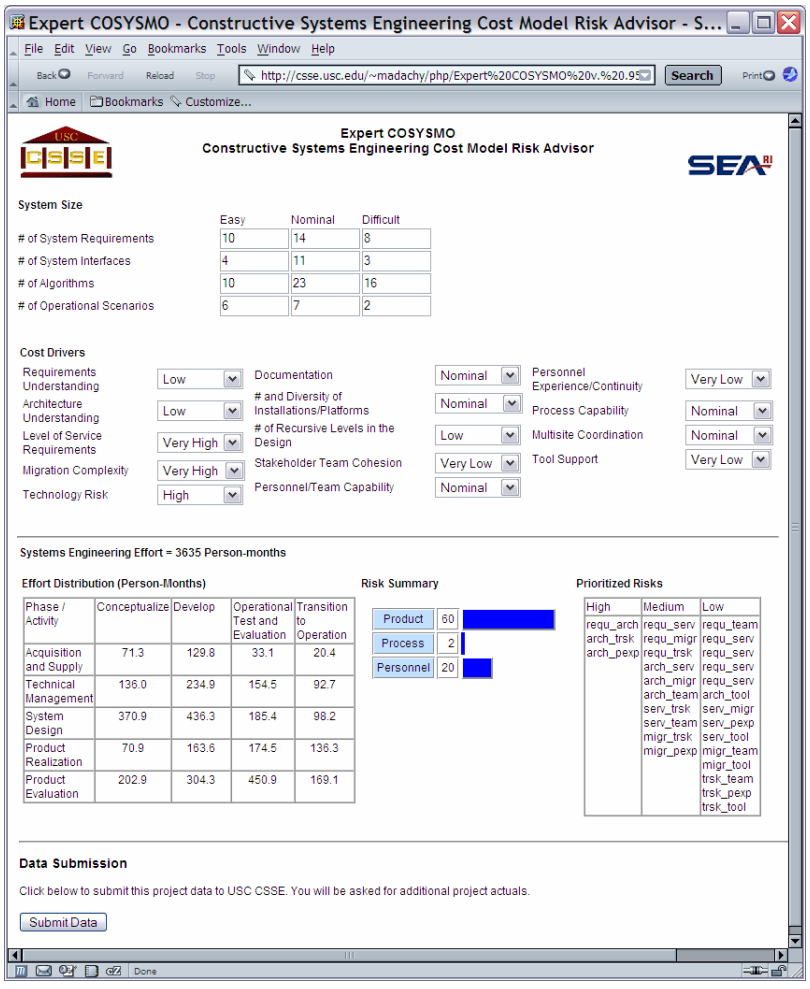

Figure 2: Sample Output (Un-scaled Risks)

Subsequently we will create more granular risk quantification rules. The initial risk assessment scheme will be elaborated into a finer grained risk assessment, and the survey will be continued. The tool will also be expanded to detect COSYSMO input anomalies.

Systems engineering risk data from industrial projects will be analyzed to enhance and refine the technique as necessary. One goal is to have the method better supported by statistical validation tests. Domain experts from industry and government will continue to provide feedback and clarification. Future work will also involve exploration of alternate risk and uncertainty approaches to eventually integrate multiple risk management viewpoints into a more complete risk management framework.