Development of User-Oriented Computational Science and Engineering Simulation Platform

Gimyeong Ryu[1], Junghyun Seo[2], Jongsuk Ruth Lee[3]

Korea Institute of Science and Technology Information, Daejeon, Republic of Korea

[1]symsonic@kisti.re.kr, [2]jerry@kisti.re.kr, [3]jsruthlee@kisti.re.kr

ABSTRACT

Simulation is one of the most effective ways to quickly test failures in the field of engineering. With the increase of computing power, engineering reviews are being actively conducted through simulation, such as, for example, predicting the performance or characteristics of products through the trial-and-error method executing virtual experiments before actual experiments in the sphere of computational science and engineering. In Korea, the education-research integration through simulation on the net (EDISON), a computational science engineering simulation platform, has been developed to provide a web-based educational and research convergence environment that can be easily accessed and used by students and researchers anytime, anywhere. In this study, to establish a better simulation environment, we analyzed user requests through a survey conducted in universities that use EDISON. The results of the survey revealed four major fields of interest. Based on the request analysis results, the previous version of the platform was modified and supplemented, and an upgraded EDISON 3.0 was released.

INTRODUCTION

Recently, computational science and engineering research fields, such as physics and chemistry, mechanical engineering, and biotechnology, have been gaining attention in terms of possibilities for applying cyber infrastructure environments based on high-performance computing and high-speed networks to resolve various challenges [1]. In the United States, the HUBzero project has already resulted in the development of a web-based platform that dynamically supports more than 60 computational science education and convergence research environments, and it is used by more than two million people annually at universities, research institutes, and industries [2]. Similarly, EDISON, a computational science and engineering simulation platform with open source software, was developed in Korea. Thereafter, it has been used by more than 10,000 users in a year since 2011 [3]. EDISON provides a web-based research environment that can be accessed and used by developers and users anytime, anywhere, which aids in solving problems in computational science and engineering fields without the need for expensive laboratory equipment and license fees. This paper introduces the concepts of EDISON 3.0 beta, which has been amended as a result of modifications and supplements based on the requirements collected through user surveys.

USER SATISFACTION SURVEY

Every year, user satisfaction surveys are conducted to understand the requirements of the science and engineering community at universities, which use the EDISON platform. As depicted in Figure 1, during the past year, 39 universities, 304 courses, and 9,629 students have been using the EDISON platform, with 3,248 (33.7%) users responding to the survey. Among them, the representative requests of 768 students, who provided answers to the short-term questionnaire are summarized in Table 1 below. In general, there are four major additions suggested by users: tutorial addition (257),

interactive environment (189), digital workbench (176), and postprocessor support (146). Based on the survey's answers, the EDISON development team attempted to improve the deficiencies of the previous version of the EDISON simulation platform.

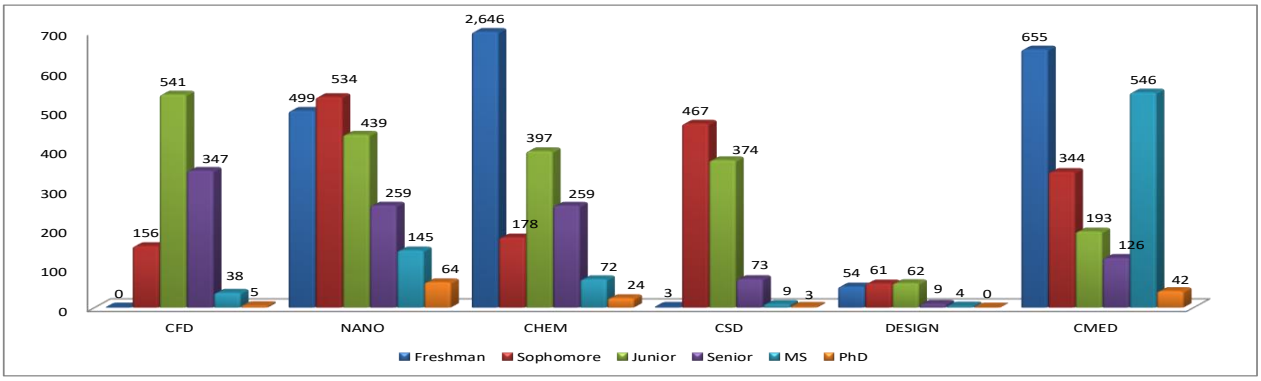

Figure 1: 2018 EDISON user statistics

Table 1: Representative Requirements in Surveys

Specialized field	Representative requirements	Ratio(%)
CFD	Interlocking of Pre-Post process	11.5
NANO	Workbench required	22.7
CHEM	Visualization of data input and output	11.2
CSD	Manual improvement	15.4
DESIGN	Improved intuitiveness of design tools	24.6
CMED	Add tutorial	14.6

DESIGN AND DEVELOPMENT OF THE SYSTEM

The EDISON platform has been modified and supplemented on top of the previous system to focus on introducing the four new functions discussed above. First, the digital workbench environment was developed, so that users could process the entire simulation on the single screen. Within this workbench screen, data visualization was implemented through the visualization tools to reduce the gap between theoretical and experimental physics. In addition, the workflow function was developed within the interactive environment to simultaneously simulate related SW. Finally, a tutorial environment was implemented to enable the better explanation of the simulation process in conjunction with the e-learning content.

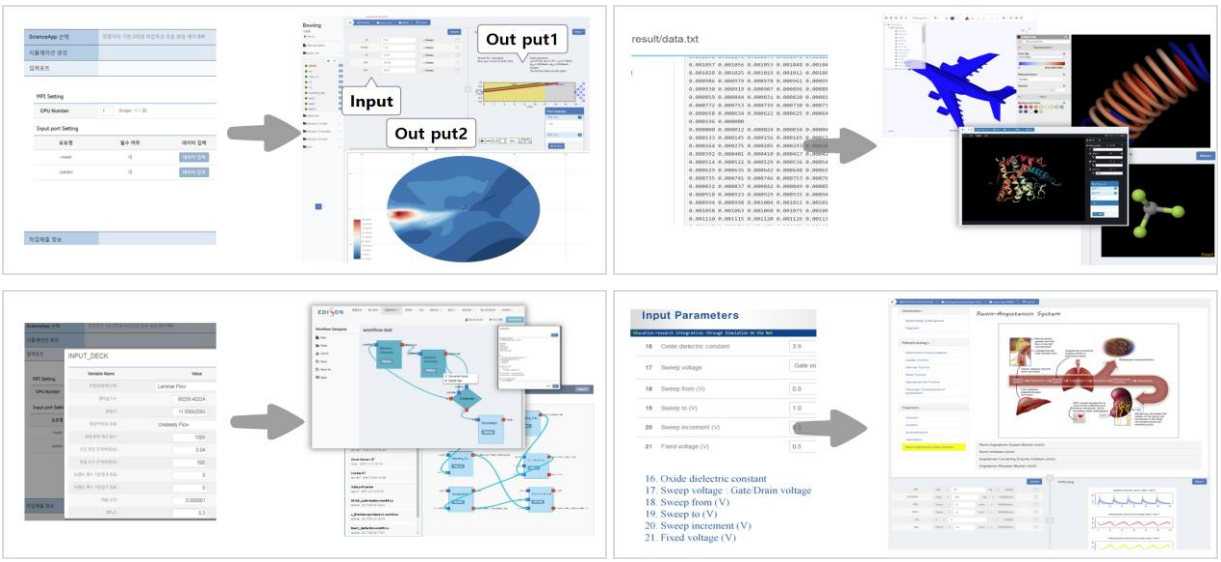

Figure 2: Modification of the main 4 requests

CONCLUSIONS

The results of the conducted survey enabled the summarizing of the four key user requirements, and the EDISON platform development team released the EDISON 3.0 version as a result of the revision and supplementary work. As the base for computational science and engineering expands, computing simulation SW is widely used not only for industrial sites but also for education and research purposes at universities. The upgraded EDISON is an open platform that allows researchers to receive one-stop services in a web-based environment adapted to perform simulation, data collection, storage, and analysis. Based on these advantages, it is expected to minimize the financial burden caused by purchasing the commercial software, and further maximize the educational effect within the engineering universities.

ACKNOWLEDGEMENTS

This research was supported by the KISTI program (No. K-19-L02-C05-S01). This research was supported by the EDISON Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science & ICT (No. NRF-2011-0020576)

REFERENCES

1. Young-Kyoon, Suh, Kum Won Cho, “Construction and Service of a Web-based Cyber-learning Platform for the Computational Science and Engineering Community in Korea.” Journal of Internet Computing and Services (JICS), vol. 17, no. 4, pp. 115-125, Aug. 2016.

2. M. McLennan, R. Kennell, “HUBzero: A Platform for Dissemination and Collaboration in Computational Science and Engineering,” IEEE Design & Test, vol.12, no. 2, pp. 48-53, March 2010.

3. EDISON. Available from: https://www.edison.re.kr, accessed 23 August 2019.