CHAPTER I
INTRODUCTION

Environmental and sustainability awareness has lately gained much importance because of increasing depletion of natural resources, need for more efficient process-operations and product manufacturing together with sustainable waste disposal. Life Cycle Assessment (LCA) has been developed as a tool for supporting the decision making which has ability to quantify the environmental impacts of products, processes, and services over the entire life cycle. LCA has been applied for wide range of applications such as research, process development, process chain weakness identifying, and process design for comparing.

The main problem of LCA is time consuming when the environmental impacts of many processes, which contain a large pool of data (i.e. input and output flows), are evaluated and compared to identify better products and/or processes. Therefore, LCA software has been developed in order to solve this problem. Although several LCA software have been developed with evaluation performance as well as reliability of assessment results, they are not yet integrated to process synthesis design tools. From a process synthesis-design point of view, there is still need a simple software which has ability to be integrated with other process synthesis design tools such as process simulation, economic evaluation, sustainable process design.

LCSoft (Piyarak, 2012; Kalakul *et al.*, 2014) has been developed to fulfill this requirements under the concept of user-friendly interface such that the user can perform LCA by using LCSoft easily, effectively, and integrated with process simulation, economic analysis tool, ECON (Saengwirun, 2011); sustainable process design tool, SustainPro (Carvalho *et al.,* 2013)

The purpose of this research was to develop new version LCSoft in order to enhance software performance. The development framework was divided into four man tasks; (1) development of Life Cycle Inventory calculation function; (2) extension the LCSoft database and improvement of impact categories in LCIA calculation; (3) development of contribution analysis; (4) validation and improvement of LCSoft. This would help enhancing the reliability of LCA results and LCSoft software. Scope of this work was divided into 4 parts; (1) LCI calculation was developed by matrix inversion and validated by using case study of acetic acid (98 %) production obtained from ecoinvent database v2.0 (Althaus *et al.*, 2007); (2) extension of LCI database covers all database that are currently available in U.S. LCI database; (3) Improved impact categories in new version of LCSoft consist of energy consumption, mineral extraction, deposited wastes, and water resource consumption and case study of acetic acid (98 %) production obtained from ecoinvent database v2.0 (Althaus *et al.*, 2007) was used to validate new impact categories; (4) development of contribution analysis consists of development of process contribution, LCI contribution, and LCIA contribution and case study of bioethanol production from cassava rhizome (Mangnimit, 2013) was used to validate contribution analysis function. The results from validation of LCI calculation, new impact categories, and contribution analysis were compared with commercial LCA software, SimaPro7.1 in order to identify deficiencies for further improvement. The validation results indicated that LCSoft and its developed functions, including LCI calculation function, new impact categories in LCIA calculation, and contribution analysis function, could give accurate as well as reliable assessment results with wider application range from extend inventory database.