Professional Leave Report Cover Sheet

Name: Sunantha Teyarachakul

Department: Information Systems & Decision Sciences

College: Craig School of Business

Leave taken: ◉ Sabbatical ○ Difference in Pay ○ Professional Leave without Pay

Time Period: ○ Fall

◉ Spring 2023

○ Academic Year

○ Other

Your report will be sent to your Dean for your PAF and to the Library Archives.

SABBATICAL LEAVE REPORT
Dr. Sunantha Teyarachakul
Department of Information Systems and Decision Sciences
Craig School of Business

Section 1: Reporting on the Success of the Leave

My goals for sabbatical leave in Spring 2023 are (1) to complete research projects relevant to learning and forgetting in manufacturing environment, write manuscripts and submit them to Peer-Reviewed Journals for publication consideration; and (2) to improve the curriculum of Data Analytics option in the Craig School of Business (CSB). During Spring 2023, I spent the majority of my time at Purdue University, Lafayette, Indiana, working with my research collaborator, Dr. Suresh Chand, an Associate Dean of Graduate Studies, and Louis A. Weil Jr., Chair of Management at Purdue University.

(a) An analysis of the accomplishments of the leave in relation to the objectives / goals of the original proposal.

Significant progress was made for the project "Lot Sizing with the Processing-Time and Setup Learning and Forgetting." The specific accomplishments include the completion of : (1) mathematical model formulation with combined processing-time and setup learning and forgetting effects. The best predictor and realistic learning and forgetting models were used; (2) development of the dynamic programming optimal algorithm and Forms of the Optimal Policy (FOOP); (3) Computational Study involving the Visual Basic programing and solving 4851 problems using various learning and forgetting parameters and models. To date, the final draft of the manuscript is under preparation for a journal submission.

In addition, the project results were presented in the European Decision Sciences Institute (EDSI) in June 2023. The conference theme is "Building Resilience for Sustainable Transition". I have extensive experience of working in France as a faculty member. This conference meeting gave me an opportunity to continue networking with international scholars and pursuing my research endeavor and interest. In the conference, I received valuable comments and interesting questions that are helpful to my project. I had the opportunity to discuss with conference participants more details of the project.

In Spring 2023, I observed the curriculum of Purdue University's Business Analytics Major and compared it with CSU-Fresno's Data Analytics Option. I found that a course of Spreadsheet Modeling and Simulation is available there but not here. This course covers the practical simulation applicable to a wide range of business expertise (e.g. finance, accounting, marketing, management, economics). I then discussed the possibility of creating a new course of such or incorporating the content of it to the Prescriptive Analytics course. My discussion was with my department chair, Dr. Yertai Tanai, and the

current Data Analytics course instructor, Dr. Kamil Cifti. I offered my availability to teach DS 140: Prescriptive Analytics to them.

(b) A description of the modifications, if any, of the original proposal and the circumstances with which necessitated these modifications.

For the research project of Supply Chain Management with Learning and Forgetting, I was struggling with deriving the optimal algorithms due to the complication of the coordination nature in the supply chain and the interactive effects of learning and forgetting. I therefore viewed the problem with the break-down chain optimization or individual stage optimization. Specifically, under learning and forgetting in batch processing time, Case 1: given the retailer optimal decision, the optimal decision for manufacturer is then made correspondingly. Case 2: without consideration of retailer optimal decision, the manufacturer makes its optimal production schedule. The retailer then uses the manufacturer schedule to make its own optimal ordering schedule. Case 3: given Cases 1 and 2, search for a better decision. At Case 3 the optimal solution will be found. With this new way and sequential procedures of obtaining the optimal solution, the experiment, specific mathematics algorithm and the search method are in the development stage.

(c) The goals of the original proposal that were not accomplished.

As discussed in (b), there is modification of the dimensions in deriving the optimal supply chain decision for the project of Supply Chain Management with Learning and Forgetting. Therefore, the optimal algorithm is in the process of development.

Section 2. Benefits to you as a faculty member

The following objectives were fulfilled by my leave in Spring 2023.

(a) **How the leave has led me to a greater command of subject matter**

I have made significant progress toward the completion of project "Lot Sizing with the Processing-Time and Setup Learning and Forgetting." My accomplishment is made possible by the leave. My conference presentation was made as a way to disseminate the research findings to conference attendees. The completion and publication of this project will enhance the subject knowledge in the area of Decision Sciences applications in production scheduling under learning and forgetting. Specifically, the optimal algorithm provides the minimum-cost production-schedule and solution to when to produce and how much to produce under the interactive effect of learning and forgetting in processing time and setups.

Additionally, research publication makes the research findings to be known and disseminated to the PRJ reviewers, editor, and professionals in operations and inventory management.

(b) How the leave might lead to creative activities in one's field or closely related field.

The constructive feedback from conference attendants, the PRJ reviewers, and the editor is useful for further research advancement and new projects. Research work is extended to new research and activities for decision science applications and cross disciplinary research such as marketing, human resources, and decision sciences.

I recently have been invited as a speaker for the 2024 Annual Conference of the Society of Research Development (SRD). The invitation has been accepted with the planned presentation of my project work obtained from this sabbatical leave. I will benefit from exchanging knowledge and ideas with the participants, conference organizer, and the SRD management team. This contributes to achieving the goals of scholarship of discovery and professional development.

(c) How the leave has led to a command of advanced methods of teaching.

The research results are interesting discussion topics for classes of Decision Science, Operations and Procurement Management, and Supply Chain Management.

With incorporation of the content, Spreadsheet Modeling and Simulation, to Data Analytics curriculum, the simulation software (i.e. @Risk, SimQuick, and RiskOptimizer) will be introduced to the students and will enhance students' skill in using simulation for business decision making.

Section 3. Benefit to the university

The benefits of my sabbatical leave to the Department of Information Systems and Decision Sciences, the Craig School of Business, and the University, are listed below.

- The publication and conference presentation of the research project as mentioned earlier will promote visibility and reputation of the school and university.
- I have a firm target of the A*/A quality journals for publications. This target was achieved in the past. With my work collaboration with Dr. Suresh Chand, I am confident of achieving this target. The achievement will further enhance the visibility and reputation of Craig School of Business and CSU-Fresno.
- My acquired knowledge of Purdue University's Business Analytics curriculum during the leave will be used for making improvement in our Data Analytics option. This will enhance student skills and readiness for the competitive job market.

Section 4. Original Proposal

A copy of the sabbatical proposal is attached to this report.

Section 5. Seminar

Craig School of Business (CSB) arranged five presentations by faculty awarded sabbaticals. My presentation is one of the five and it was made on Friday October 6, 2023, at 11:00am in room PB 194. I made additional presentations in the 2023 European Decision Sciences Institute (EDSI) Conference and the 2024 Annual Conference of the Society of Research Development.

SABBATICAL PROPOSAL
Dr. Sunantha Teyarachakul (Prime)
Department of Information Systems and Decision Sciences
Craig School of Business

Section 1: The Proposal

Sabbatical application for Spring 2023, the three activities planned are scheduled to take place Spring 2023 and Summer 2023 as follows:

1) **Research Project 1: Supply Chain Management with Learning and Forgetting**. Decision sciences and operation research tools are used in the project analysis. The goal of my leave is to complete and submit this research for a Peer-Reviewed Journal for publication consideration.

   This research focuses on a two-stage supply chain, consisting of one manufacturer and one retailer, and assumed that worker learning and forgetting occurs in processing units in a batch manufacturing environment. Our analysis is to examine the combined effects of lot sizing, as well as learning and forgetting on a manufacturer-retailer channel. The research plan is to develop the optimal algorithm that can identify the best cooperative policy for the supply chain, run the extensive computer simulations, and use the results to specify managerial insights. The leave for one semester provides me time to complete this project.

   See the proposal of this project in Exhibit 1.

2) **Research Project 2: Lot Sizing with the Processing-Time and Setup Learning and Forgetting.**

   This research focuses on the combined effects of setup and processing-time learning and forgetting on batch sizes. It is an extension of the projects: (1) Effect of Learning and Forgetting on Batch Sizes considering learning and forgetting in unit processing time, and (2) Learning and Forgetting in Setup. The extension is to analyze the interactive effects of Processing-Time and Setup Learning and Forgetting.

   The research goal is to develop an algorithm and the policies to find optimal production schedules. This project is at its infancy and thus the procedural plan is to: formulate the mathematic model with combined processing-time and setup learning and forgetting effects; examine the forms of optimal policy (FOOPs); and develop the optimal algorithm. If possible, the decision and forecast horizon will be part our analysis.

   My leave will be used to complete and submit this research for a Peer-Reviewed Journal for publication consideration.

For both projects, my research collaborator is Dr. Suresh Chand, an Associate Dean of Graduate Studies at Purdue University, Krannert School of Management. He also holds a position of Louis A Weil Jr. Chair of Management at Purdue University. I plan to visit Purdue and work with him on both projects during the leave. This planned travel will enhance the collaboration and facilitate the interactive progression toward the completion of both projects.

3) **Spring 2023: Improve the Data Analytics Curriculum.**
   At Krannert Graduate School of Management in the Purdue University, a number of courses and curriculums relevant to Data Analytics will be observed during my sabbatical leave. I am particularly interested in the course Modeling and Predictive Analysis which in my understanding is not offered in the Data Analytics option available the Craig School of Business (CSB). I will observe and attend classes relevant to Sciences in Analytics and will apply my acquired knowledge during the leave to improve CSB Data Analytics Curriculum.

Section 2: Benefits as a Faculty Member

The progression and completion of my research projects contribute to building new knowledge of (1) production scheduling (eg. when to produce and/or order units), and (2) supply chain coordination (eg. self-serving-focus supply chains, the misalignment between incentives and decisions of retailers and manufacturers, and the appropriate policy to coordinate their lot-sizing decisions), under learning and forgetting environments. Leave for research work will enhance subject matter in the area of Decision Sciences Applications.

Publication and conference presentations will allow the research findings to be known and disseminated to conference attendants, PRJ reviewers, editor, and professionals in operations, inventory management. Research results are interesting discussion topics for future classes on Decision Science, Operations and Procurement Management, and Supply Chain Management. Additionally, constructive feedback is useful for further research advancement and new projects. Research work lead to new research and activities for decision science applications.

Additionally, acquiring knowledge relevant to Sciences in Analytics will strengthen and advance my knowledge of data analytics and consequently allow me to be a greater contributor to our data analytics curriculum.

Section 3: Benefits to the University

The activities planned for this sabbatical request would benefit the Department of Information Systems and Decision Sciences, the Craig School of Business and the University as a whole.

- The intended research in Supply Chain Management with Learning and Forgetting and Lot Sizing with the Processing-Time and Setup Learning and Forgetting are critical topics. That will promote visibility and reputation of the school and university.
- My targeted journals for publications are the A and A* journals listed in the ABDC Quality Journal List. From past collaborative research project, working with Dr. Suresh Chand,

our goals for top-tier journal publications were achieved. I am confident that this will further enhance the visibility and reputation of Craig School of Business and CSU-Fresno.

- Data Analytics Option is gaining popularity and several universities have been offering the same or similar specialization. Continuous improvement of Data Analytics Curriculum will enhance student skills for the competitive job market.

Section 4: Previous Leaves

There are no previous leaves.

Exhibit 1: Research Proposal

Title: Supply Chain Management with Learning and Forgetting

Abstract: We considered a two-stage supply chain, consisting of one manufacturer and one retailer, and assumed that worker learning and forgetting occurs in processing units in a batch manufacturing environment. Specifically, we analyzed the combined effects of lot sizing, as well as learning and forgetting on a manufacturer-retailer channel. Our analysis is simplified to assume the case of a single product. The retailer is assumed to face a constant demand rate over an infinite time horizon; therefore, the retailer's Forms of Optimal Policy (FOOP) are: (1) to order the same quantity for each purchase; (2) to place an order at regular intervals, and (3) in the periods that orders arrive, inventory is reaching its zero point. FOOP for the manufacturer are to produce the product in batches at a finite production rate, and deliver them to the retailer in a number of shipments. Not only we investigate self-serving-focus supply chains, in which the members' primary concern relies with optimizing their own objectives; but also, we study supply chain's optimal cooperative policies. We are developing the optimal algorithm that can identify the best cooperative policy for the supply chain; our policy provides solutions to the questions of when to produce and how much to produce for a manufacturer, and also offers solutions to the questions of when to order and how much to order for a retailer. We believe that our work will provide additional managerial insights on how to improve supply chain efficiency given the presence of unit-processing learning and forgetting.

Supply Chain Cost: retailers incur the inventory cost for holding finished goods and the ordering cost (e.g. transportation and order-processing costs). Manufacturers incur cost of setting up the production lines, inventory cost of holding finished items during production intervals and thereafter, as well as labour costs. Labour cost is influenced by worker learning and forgetting. Supply chain cost is obtained by combining costs incurred at both stages. Note that we assume all demand must be satisfied.

Research Goal: to develop the optimal cooperative policy for the supply chain given the presence of unit-processing learning and forgetting, to formulate the dynamic lot sizing model to find the optimal lot sizing decisions for both retailer and manufacturers, and to provide managerial insight of how learning and forgetting in processing time affects the optimal production schedules.

Procedural Plan:

- Preliminary work and results include development of long-term characteristics of learning retention at the start of each batch. Secondly, mathematical expressions for costs incurred at retailer, manufacturer, and the entire supply chain levels are completed.
- We will develop the minimal-cost algorithm providing the best production and ordering schedules for manufacturer and retailer.
- We will run computer simulations for thousands of examples to obtain managerial insights.
- Upon project completion, we will submit articles to PRJs for publication consideration.
- We will share research findings by presenting them at professional conferences.

Expected Outcome of Our Research

Our research contributions provide a deeper understanding into the combined effects of lot sizing, as well as learning and forgetting that occurs on a manufacturer-retailer channel. Specifically, our research will provide the policies which enhance efficiency and effectiveness of coordinating the movement of materials, products and information flows amongst manufacturers and retailers.