รายงานวิจัย

เรื่อง

ความสำเร็จในการเรียนERPสำหรับผู้เรียนระดับต้น: จากมุมมองแบบTAM

Achievement in ERP learning for entry-level learners: From a TAM perspective

ผู้วิจัย

ดร.ปาลีรัฐ เลขะวัฒนะ

คณะบริหารธุรกิจ

สถาบันเทคโนโลยีไทย-ญี่ปุ่น

ปีการศึกษา2559

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ภาคผนวก

ภาคผนวก ก.

แบบสอบถาม (Questionnaire)

แบบสอบถามเพื่องานวิจัย ครั้งที่ 1

ความสำเร็จในการเรียนERPสำหรับผู้เรียนระดับต้น: จากมุมมองด้านการยอมรับเทคโนโลยี

คำชี้แจง

1. แบบสอบถามนี้สำหรับนักศึกษาที่ลงเรียนSAPเป็น**ครั้งแรกเท่านั้น** (นักศึกษารีเกรด ไม่ต้องตอบ)
2. วัตถุประสงค์ เพื่อศึกษาความสัมพันธ์ของปัจจัยในการยอมรับเทคโนโลยีต่อการเรียนระบบERPของผู้เรียนระดับต้น
3. แบบสอบถามประกอบด้วย 2 ส่วนคือ ส่วนที่1 ปัจจัยส่วนบุคคล ส่วนที่ 2 ความคิดเห็นต่อการยอมรับเทคโนโลยี

ให้เขียนเครื่องหมาย ✓ในช่องคำตอบของท่าน

☐ นักศึกษาเรียนSAPเป็นครั้งแรก

ส่วนที่1 ปัจจัยส่วนบุคคล

1. เพศ

   ☐ ชาย ☐ หญิง

2. เกรดเฉลี่ย(GPAX)

   ☐ 3.51-4.00 ☐ 3.01-3.50 ☐ 2.51-3.00 ☐ 2.01-2.50 ☐ 1.51-2.00 ☐ 1.01-1.50

3. เกรดในวิชาBUS-210

   ☐ Aหรือ B+ ☐ Bหรือ C+ ☐ Cหรือ D+ ☐ Dหรือ F ☐ ยังไม่เคยเรียน หรือ W หรือ I

4. เกรดในวิชาBUS-211

   ☐ Aหรือ B+ ☐ Bหรือ C+ ☐ Cหรือ D+ ☐ Dหรือ F ☐ ยังไม่เคยเรียน หรือ W หรือ I

5. จำนวนชั่วโมงต่อวันในการใช้คอมพิวเตอร์

   ☐ ไม่ใช้เลย ☐ 1-3ชั่วโมง ☐ 4-6ชั่วโมง ☐ มากกว่า 6 ชั่วโมง

6. จำนวนชั่วโมงต่อวันในการใช้โทรศัพท์มือถือ

   ☐ ไม่ใช้เลย ☐ 1-3ชั่วโมง ☐ 4-6ชั่วโมง ☐ มากกว่า 6 ชั่วโมง

7. การใช้คอมพิวเตอร์ในข้อ 5 มีวัตถุประสงค์ของการใช้เพื่ออะไร

   สำหรับข้อนี้ ให้เขียนลำดับการใช้ 1 2 3 4 5 (คำอธิบาย 1 หมายถึงใช้มากที่สุด และ 5 หมายถึงใช้น้อยที่สุด)

   ☐ เพื่อทำงานพิเศษนอกเหนือจากการเรียนที่มหาวิทยาลัย ☐ เพื่อทำแบบฝึกหัดและฝึกฝนสิ่งที่เรียนมาจากมหาวิทยาลัย

   ☐ เพื่อฝึกใช้โปรแกรมบางอย่างที่สนใจเช่น ตัดต่อVDO ☐ เพื่อความสนุกสนานจากSocial mediaเช่น เล่นเกมส์, Youtube

   ☐ อื่นๆ_____

ให้เขียนเครื่องหมาย ✓ในช่องคำตอบที่ตรงกับความคิดเห็นของท่านที่สุด

ส่วนที่ 2 ความคิดเห็นต่อการยอมรับเทคโนโลยี

	ระดับความคิดเห็น				
	5	4	3	2	1
	เห็นด้วยมากที่สุด	เห็นด้วยมาก	เห็นด้วยปานกลาง	เห็นด้วยน้อย	เห็นด้วยน้อยที่สุด
การรับรู้ถึงประโยชน์					
1.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPสามารถเพิ่มคุณสมบัติของนักศึกษาในการหางานในอนาคต					
2.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPสามารถนำไปเขียนในResumeเพื่อหางานในอนาคต					
3.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPทำให้สามารถเริ่มทำงานกับบริษัทที่ใช้ระบบERP/SAPได้ทันทีโดยที่ไม่ต้องเริ่มฝึกหัดใหม่					
4.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPมีประโยชน์ต่อการทำงานของนักศึกษาในอนาคต					
5.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPมีผลต่อเกรดที่จะได้รับในวิชาการวางแผนและควบคุมการผลิตIMA-314					
การรับรู้ว่าง่ายต่อการใช้งาน					
1.ระบบERP/SAPง่ายต่อการเข้าใจเรียนรู้					
2.ระบบERP/SAPง่ายต่อการนำไปใช้งานในการทำงานในอนาคต					
3.นักศึกษาสามารถทำความคุ้นเคยกับระบบERP/SAPได้ง่าย					
4.นักศึกษาสามารถเข้าใจหน้าจอต่างๆในระบบERP/SAPได้ง่าย					
5.นักศึกษาสามารถติดตามการสอนของอาจารย์ในห้องเรียนได้ทัน					
บรรทัดฐานในสังคม					
1.นักศึกษาที่จบด้านการจัดการอุตสาหกรรมควรมีความรู้เข้าใจเรื่องระบบERP					
2.บริษัทที่ทันสมัยในปัจจุบันมักใช้ระบบERPในบริษัท					
3.พนักงานที่ทำงานในบริษัทต้องมีความสามารถในการใช้หรือมีความรู้เข้าใจเกี่ยวกับระบบERP					
ภาพลักษณ์					
1.นักศึกษาที่มีความรู้เข้าใจเกี่ยวกับระบบERP/SAPดูเป็นคนทันสมัยตามยุค					
2.นักศึกษาที่มีความรู้เข้าใจเกี่ยวกับระบบERP/SAPจะเป็นที่ต้องการของบริษัท					
ความเกี่ยวข้องสัมพันธ์กับงานในอนาคต					
1.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPมีความสำคัญกับงานในอนาคต					
2.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPมีความเกี่ยวข้องกับงานในอนาคต					
คุณภาพของผลลัพธ์ที่จะได้จากระบบERP/SAP					
1.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPสามารถได้งานในบริษัทที่ต้องการจะเข้าและเงินเดือนที่ต้องการ					
2.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPสามารถทำงาน(ในอนาคต)ได้บรรลุตามที่บริษัทต้องการ					
ความสามารถในการแสดงผล					
1.นักศึกษาสามารถแสดงการช่วยเหลือเพื่อนร่วมชั้นได้ ในกรณีที่นักศึกษาทำงานเสร็จก่อนตามFlowการทำงานในห้องเรียน					
2.นักศึกษาสามารถอธิบายผลลัพธ์และปัญหาในระหว่างการเรียนได้เพื่อขอความช่วยเหลือจากอาจารย์					

ส่วนที่ 2 ความคิดเห็นต่อการยอมรับเทคโนโลยี (ต่อ)

	ระดับความคิดเห็น				
	5	4	3	2	1
	เห็นด้วยมากที่สุด	เห็นด้วยมาก	เห็นด้วยปานกลาง	เห็นด้วยน้อย	เห็นด้วยน้อยที่สุด
ความสามารถส่วนบุคคลในการใช้งาน					
1.นักศึกษามั่นใจว่าตัวเองมีความรู้พื้นฐานที่เพียงพอในฝึกปฏิบัติระบบERP/SAP ถ้าจะต้องเรียนรู้ด้วยตัวเอง					
2.นักศึกษามั่นใจว่านักศึกษาสามารถใช้งานERP/SAPด้วยตัวเอง ถ้าจะต้องทำซ้ำFlowที่เคยเรียนอีกครั้ง					
3.นักศึกษาสามารถนำความรู้ที่เรียนมาไปประยุกต์ใช้งานในระบบERPระบบอื่นในที่ทำงานในอนาคตได้					
การควบคุมจากปัจจัยภายนอก					
สิ่งต่อไปนี้เป็นปัจจัยที่ทำให้เพิ่มการเรียนรู้ระบบERP/SAPของนักศึกษาหรือไม่					
1.คอมพิวเตอร์และอินเตอร์เนตที่บ้าน					
2.Websiteที่เกี่ยวกับระบบERP/SAP					
3.ห้องคอมพิวเตอร์ในมหาวิทยาลัยสำหรับฝึกนอกเวลาเรียน					
4.ความสามารถในภาษาอังกฤษ					
ความวิตกกังวล					
1.นักศึกษามีความวิตกกังวลหรือความกลัวในการใช้คอมพิวเตอร์					
2.นักศึกษาไม่มีความคุ้นเคยกับการใช้คอมพิวเตอร์					
3.นักศึกษามีความวิตกกังวลในการใช้Softwareหรือโปรแกรมคอมพิวเตอร์					
ความสนุกสนาน					
1.นักศึกษารู้สึกสนุกกับการค้นหาข้อมูลต่างๆในระบบERP/SAP					
2.นักศึกษารู้สึกสนุกกับการเรียนรู้จากการแก้ปัญหาที่เกิดจากการคีย์ข้อมูลผิด					
3.นักศึกษารู้สึกสนุกกับการได้ค้นพบว่าระบบERP/SAPสามารถทำอะไรได้หลายๆอย่างในการจัดการข้อมูลทั้งองค์กร					
ความเพลิดเพลิน					
1.นักศึกษามีความเพลิดเพลินในการเรียนตามFlowการทำงานในห้องเรียน					
2.นักศึกษามีความเพลิดเพลินอยากจะทำงานให้จบFlowการทำงานในห้องเรียน					
3.นักศึกษามีความเพลิดเพลินอยากจะค้นพบต่อไปเกี่ยวกับTransactionใหม่ที่ระบบERP/SAPจะทำได้					
ความสามารถในการใช้เพื่อบรรลุผลตามเป้าหมาย					
1.นักศึกษาคิดว่าสามารถทำงานตามFlowในห้องเรียนได้ในเวลาเหมาะสมทำงานเสร็จได้โดยไม่ช้าเกินไป					
2.นักศึกษาสามารถแก้ปัญหาระหว่างการเรียนและติดตามการสอนของอาจารย์จนจบFlowการทำงานในห้องเรียน					

แบบสอบถามเพื่องานวิจัย ครั้งที่ 2

ความสำเร็จในการเรียนERPสำหรับผู้เรียนระดับต้น: จากมุมมองด้านการยอมรับเทคโนโลยี

คำชี้แจง

4. แบบสอบถามนี้สำหรับนักศึกษาที่ลงเรียนSAPเป็น**ครั้งแรกเท่านั้น** (นักศึกษารีเกรด ไม่ต้องตอบ)
5. วัตถุประสงค์ เพื่อศึกษาความสัมพันธ์ของปัจจัยในการยอมรับเทคโนโลยีต่อการเรียนระบบERPของผู้เรียนระดับต้น
6. แบบสอบถามประกอบด้วย 4 ส่วนคือ ส่วนที่1 ปัจจัยส่วนบุคคล ส่วนที่ 2 ความคิดเห็นต่อการยอมรับเทคโนโลยี ส่วนที่ 3 ระดับคะแนนสอบSAP ส่วนที่ 4 ทัศนคติที่สะท้อนความสำเร็จในการเรียน

ส่วนที่1 ปัจจัยส่วนบุคคล

ให้เขียนเครื่องหมาย ✓ในช่องคำตอบของท่าน ***ในทุกข้อยกเว้นข้อ 7ที่ให้ใส่เป็นตัวเลข**

8. เพศ

☐ ชาย ☐ หญิง

9. เกรดเฉลี่ย(GPAX)

☐ 3.51-4.00 ☐ 3.01-3.50 ☐ 2.51-3.00 ☐ 2.01-2.50 ☐ 1.51-2.00 ☐ 1.01-1.50

10. เกรดในวิชาBUS-210

☐ Aหรือ B+ ☐ Bหรือ C+ ☐ Cหรือ D+ ☐ Dหรือ F ☐ ยังไม่เคยเรียน หรือ W หรือ I

11. เกรดในวิชาBUS-211

☐ Aหรือ B+ ☐ Bหรือ C+ ☐ Cหรือ D+ ☐ Dหรือ F ☐ ยังไม่เคยเรียน หรือ W หรือ I

12. จำนวนชั่วโมงต่อวันในการใช้คอมพิวเตอร์

☐ ไม่ใช้เลย ☐ 1-3ชั่วโมง ☐ 4-6ชั่วโมง ☐ มากกว่า 6 ชั่วโมง

13. จำนวนชั่วโมงต่อวันในการใช้โทรศัพท์มือถือ

☐ ไม่ใช้เลย ☐ 1-3ชั่วโมง ☐ 4-6ชั่วโมง ☐ มากกว่า 6 ชั่วโมง

14. การใช้คอมพิวเตอร์ในข้อ 5 มีวัตถุประสงค์ของการใช้เพื่ออะไร

สำหรับข้อนี้ ให้เขียนตัวเลขลำดับการใช้ 1 2 3 4 5 ในกรอบสี่เหลี่ยม (คำอธิบาย 1 หมายถึงใช้มากที่สุด และ 5 หมายถึงใช้น้อยที่สุด)

☐ เพื่อทำงานพิเศษนอกเหนือจากการเรียนที่มหาวิทยาลัย ☐ เพื่อทำแบบฝึกหัดและฝึกฝนสิ่งที่เรียนมาจากมหาวิทยาลัย

☐ เพื่อฝึกใช้โปรแกรมบางอย่างที่สนใจเช่น ตัดต่อVDO ☐ เพื่อความสนุกสนานจากSocial mediaเช่น เล่นเกมส์, Youtube

☐ อื่นๆ_____

15. นักศึกษาได้ติดตั้งโปรแกรมSAPที่คอมพิวเตอร์ส่วนตัว

☐ ได้ติดตั้งแล้ว ☐ ไม่ได้ติดตั้ง

16. ลักษณะการฝึกใช้SAPนอกเวลาเรียน (ฝึกที่ไหนก็ได้ เช่นฝึกบนคอมพิวเตอร์ส่วนตัว ฝึกบนคอมพิวเตอร์ที่ตึกAชั้น3) ***ตอบได้มากกว่า 1 ข้อ**

☐ ไม่ฝึกหรือไม่ใช้เลย ☐ ใช้เฉพาะเวลาทำตามในห้องเรียนไม่ทัน ☐ ฝึกเฉพาะเวลาก่อนสอบ ☐ ฝึกเป็นประจำ

17. ถ้าข้อ 9 ตอบว่า "ฝึกเป็นประจำ" ให้ตอบข้อ 10

ความถี่ในการฝึกเป็นประจำ เป็นกี่ชั่วโมงต่อสัปดาห์

☐ 1-2 ชั่วโมงต่อสัปดาห์ ☐ 2-5 ชั่วโมงต่อสัปดาห์ ☐ มากกว่า 5 ชั่วโมงต่อสัปดาห์

ส่วนที่ 2 ความคิดเห็นต่อการยอมรับเทคโนโลยี

ให้เขียนเครื่องหมาย ✓ในช่องคำตอบที่ตรงกับความคิดเห็นของท่านที่สุด

	ระดับความคิดเห็น				
	5	4	3	2	1
	เห็นด้วยมากที่สุด	เห็นด้วยมาก	เห็นด้วยปานกลาง	เห็นด้วยน้อย	เห็นด้วยน้อยที่สุด
(A) การรับรู้ถึงประโยชน์					
1.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPสามารถเพิ่มคุณสมบัติของนักศึกษาในการหางานในอนาคต					
2.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPสามารถนำไปเขียนในResumeเพื่อหางานในอนาคต					
3.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPทำให้สามารถเริ่มทำงานกับบริษัทที่ใช้ระบบERP/SAPได้ทันทีโดยที่ไม่ต้องเริ่มฝึกหัดใหม่					
4.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPมีประโยชน์ต่อการทำงานของนักศึกษาในอนาคต					
5.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPมีผลต่อเกรดที่จะได้รับในวิชาการวางแผนและควบคุมการผลิตIMA-314					
(B) การรับรู้ว่าง่ายต่อการใช้งาน					
1.ระบบERP/SAPง่ายต่อการเข้าใจเรียนรู้					
2.ระบบERP/SAPง่ายต่อการนำไปใช้งานในการทำงานในอนาคต					
3.นักศึกษาสามารถทำความคุ้นเคยกับระบบERP/SAPได้ง่าย					
4.นักศึกษาสามารถเข้าใจหน้าจอต่างๆในระบบERP/SAPได้ง่าย					
5.นักศึกษาสามารถติดตามการสอนของอาจารย์ในห้องเรียนได้ทัน					
(C)บรรทัดฐานในสังคม					
1.นักศึกษาที่จบด้านการจัดการอุตสาหกรรมควรมีความรู้เข้าใจเรื่องระบบERP					
2.บริษัทที่ทันสมัยในปัจจุบันมักใช้ระบบERPในบริษัท					
3.พนักงานที่ทำงานในบริษัทต้องมีความสามารถในการใช้หรือมีความรู้เข้าใจเกี่ยวกับระบบERP					
(D) ภาพลักษณ์					
1.นักศึกษาที่มีความรู้เข้าใจเกี่ยวกับระบบERP/SAPดูเป็นคนทันสมัยตามยุค					
2.นักศึกษาที่มีความรู้เข้าใจเกี่ยวกับระบบERP/SAPจะเป็นที่ต้องการของบริษัท					
(E) ความเกี่ยวข้องสัมพันธ์กับงานในอนาคต					
1.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPมีความสำคัญกับงานในอนาคต					
2.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPมีความเกี่ยวข้องกับงานในอนาคต					
(F) คุณภาพของผลลัพธ์ที่จะได้จากระบบERP/SAP					
1.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPสามารถได้งานในบริษัทที่ต้องการจะเข้าและเงินเดือนที่ต้องการ					
2.การมีความรู้เข้าใจเกี่ยวกับระบบERP/SAPสามารถทำงาน(ในอนาคต)ได้บรรลุตามที่บริษัทต้องการ					
(G) ความสามารถในการแสดงผล					
1.นักศึกษาสามารถแสดงการช่วยเหลือเพื่อนร่วมชั้นได้ ในกรณีที่นักศึกษา					

ทำงานเสร็จก่อนตามFlowการทำงานในห้องเรียน					
2.นักศึกษาสามารถอธิบายผลลัพธ์และปัญหาในระหว่างการเรียนได้เพื่อขอความช่วยเหลือจากอาจารย์					

ส่วนที่ 2 ความคิดเห็นต่อการยอมรับเทคโนโลยี (ต่อ)

	ระดับความคิดเห็น				
	5	4	3	2	1
	เห็นด้วยมากที่สุด	เห็นด้วยมาก	เห็นด้วยปานกลาง	เห็นด้วยน้อย	เห็นด้วยน้อยที่สุด
(H) ความสามารถส่วนบุคคลในการใช้งาน					
1.นักศึกษามั่นใจว่าตัวเองมีความรู้พื้นฐานที่เพียงพอในฝึกปฏิบัติระบบERP/SAP ถ้าจะต้องเรียนรู้ด้วยตัวเอง					
2.นักศึกษามั่นใจว่านักศึกษาสามารถใช้งานERP/SAPด้วยตัวเอง ถ้าจะต้องทำซ้ำFlowที่เคยเรียนอีกครั้ง					
3.นักศึกษาสามารถนำความรู้ที่เรียนมาไปประยุกต์ใช้งานในระบบERPระบบอื่นในที่ทำงานในอนาคตได้					
(I) การควบคุมจากปัจจัยภายนอก					
สิ่งต่อไปนี้เป็นปัจจัยที่ทำให้เพิ่มการเรียนรู้ระบบERP/SAPของนักศึกษาหรือไม่					
1.คอมพิวเตอร์และอินเตอร์เนตที่บ้าน					
2.Websiteที่เกี่ยวกับระบบERP/SAP					
3.ห้องคอมพิวเตอร์ในมหาวิทยาลัยสำหรับฝึกนอกเวลาเรียน					
4.ความสามารถในภาษาอังกฤษ					
(J) ความวิตกกังวล					
1.นักศึกษามีความวิตกกังวลหรือความกลัวในการใช้คอมพิวเตอร์					
2.นักศึกษาไม่มีความคุ้นเคยกับการใช้คอมพิวเตอร์					
3.นักศึกษามีความวิตกกังวลในการใช้Softwareหรือโปรแกรมคอมพิวเตอร์					
(K) ความสนุกสนาน					
1.นักศึกษารู้สึกสนุกกับการค้นหาข้อมูลต่างๆในระบบERP/SAP					
2.นักศึกษารู้สึกสนุกกับการเรียนรู้จากการแก้ปัญหาที่เกิดจากการคีย์ข้อมูลผิด					
3.นักศึกษารู้สึกสนุกกับการได้ค้นพบว่าระบบERP/SAPสามารถทำอะไรได้หลายๆอย่างในการจัดการข้อมูลทั้งองค์กร					
(L) ความเพลิดเพลิน					
1.นักศึกษามีความเพลิดเพลินในการเรียนตามFlowการทำงานในห้องเรียน					
2.นักศึกษามีความเพลิดเพลินอยากจะทำงานให้จบFlowการทำงานในห้องเรียน					
3.นักศึกษามีความเพลิดเพลินอยากจะค้นพบต่อไปเกี่ยวกับTransactionใหม่ที่ระบบERP/SAPจะทำได้					
(M) ความสามารถในการใช้เพื่อบรรลุผลตามเป้าหมาย					
1.นักศึกษาคิดว่าสามารถทำงานตามFlowในห้องเรียนได้ในเวลาเหมาะสม ทำงานเสร็จได้โดยไม่ช้าเกินไป					
2.นักศึกษาสามารถแก้ปัญหาระหว่างการเรียนและติดตามการสอนของอาจารย์จนจบFlowการทำงานในห้องเรียน					

ส่วนที่ 3 ระดับคะแนนสอบSAP

ให้เขียนเครื่องหมาย ✓ในช่องคำตอบระดับคะแนนในแต่ละครั้งการสอบ

	A (5)	B (4)	C (3)	D (2)	E (1)	ไม่เข้าสอบ
ครั้งที่ 1 (ตอบระดับคะแนนที่ได้จริง)						
ครั้งที่ 2 (ตอบระดับคะแนนที่ได้จริง)						
ครั้งที่ 3 (ตอบระดับคะแนนที่คาดว่าจะทำได้ ***ในอนาคต)						

ส่วนที่ 4 ทัศนคติที่สะท้อนความสำเร็จในการเรียน

ให้เขียนเครื่องหมาย ✓ในช่องคำตอบที่ตรงกับความคิดเห็นของท่านที่สุด

	ระดับความคิดเห็น				
	5	4	3	2	1
	เห็นด้วยมากที่สุด	เห็นด้วยมาก	เห็นด้วยปานกลาง	เห็นด้วยน้อย	เห็นด้วยน้อยที่สุด
1.นักศึกษาสนใจอยากจะเรียนรู้ระบบERPเพิ่มเติม ถึงแม้จะเรียนจบในคอร์สนี้แล้ว					
2.นักศึกษาอยากจะทำงานในสถานที่ทำงานที่มีระบบERPใช้ในการทำงาน					
3.นักศึกษาต้องการเป็นผู้เชี่ยวชาญเกี่ยวกับระบบERPในอนาคต					

ภาคผนวก ข.

Lisrel output for TAM-based influence analysis without external factors

```
!TAM
 Observed Variables
 AVEUSEFUL AVEEASY AVESCORE AVEINTENT
 Covariance Matrix from file TNIACPATH.cov
 Sample size = 88
 Relationships
 AVEUSEFUL = AVEEASY
 AVEINTENT = AVEUSEFUL AVEEASY
 AVESCORE = AVEINTENT AVEEASY
 !Show output as full Lisrel output
 Lisrel output rs sc mi ef
 Path Diagram
 End of Problem

 !TAM

        Covariance Matrix

            AVEUSEFU   AVESCORE   AVEINTEN    AVEEASY
            --------   --------   --------   --------
 AVEUSEFU      0.431
 AVESCORE      0.130      0.896
 AVEINTEN      0.226      0.259      0.768
  AVEEASY      0.142      0.184      0.186      0.444

 Total Variance = 2.539 Generalized Variance = 0.0813

 Largest Eigenvalue = 1.282 Smallest Eigenvalue = 0.285

 Condition Number = 2.120


 !TAM

 Parameter Specifications

        BETA

            AVEUSEFU   AVESCORE   AVEINTEN
            --------   --------   --------
 AVEUSEFU          0          0          0
 AVESCORE          0          0          1
 AVEINTEN          2          0          0

        GAMMA

             AVEEASY
            --------
 AVEUSEFU          3
 AVESCORE          4
 AVEINTEN          5

        PHI

             AVEEASY
            --------
                   6

        PSI

            AVEUSEFU   AVESCORE   AVEINTEN
            --------   --------   --------
                   7          8          9


 !TAM

 Number of Iterations = 0

 LISREL Estimates (Maximum Likelihood)

        BETA

            AVEUSEFU   AVESCORE   AVEINTEN
            --------   --------   --------
```

AVEUSEFU	- -	- -	- -
AVESCORE	- -	- -	0.264
			(0.113)
			2.331
AVEINTEN	0.432	- -	- -
	(0.136)		
	3.187		

GAMMA

	AVEEASY
AVEUSEFU	0.320
	(0.100)
	3.204
AVESCORE	0.305
	(0.149)
	2.044
AVEINTEN	0.280
	(0.134)
	2.095

Covariance Matrix of Y and X

	AVEUSEFU	AVESCORE	AVEINTEN	AVEEASY
AVEUSEFU	0.431			
AVESCORE	0.103	0.896		
AVEINTEN	0.226	0.259	0.768	
AVEEASY	0.142	0.184	0.186	0.444

PHI

	AVEEASY
	0.444
	(0.067)
	6.595

PSI

Note: This matrix is diagonal.

AVEUSEFU	AVESCORE	AVEINTEN
0.386	0.771	0.618
(0.058)	(0.117)	(0.094)
6.595	6.595	6.595

Squared Multiple Correlations for Structural Equations

AVEUSEFU	AVESCORE	AVEINTEN
0.106	0.139	0.195

NOTE: R² for Structural Equatios are Hayduk's (2006) Blocked-Error R²

Reduced Form

	AVEEASY
AVEUSEFU	0.320
	(0.101)
	3.186
AVESCORE	0.415
	(0.147)
	2.835

```
AVEINTEN      0.419
             (0.134)
               3.114


        Squared Multiple Correlations for Reduced Form

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
              0.106      0.085      0.101

                              Log-likelihood Values

                        Estimated Model          Saturated Model
                        ---------------          ---------------
 Number of free parameters(t)          9                       10
 -2ln(L)                         131.444                 131.201
 AIC (Akaike, 1974)*             149.444                 151.201
 BIC (Schwarz, 1978)*            171.740                 175.974

*LISREL uses AIC= 2t - 2ln(L) and BIC = tln(N)- 2ln(L)


                           Goodness-of-Fit Statistics

 Degrees of Freedom for (C1)-(C2)                      1
 Maximum Likelihood Ratio Chi-Square (C1)              0.244 (P = 0.6214)
 Browne's (1984) ADF Chi-Square (C2_NT)                0.244 (P = 0.6217)

 Estimated Non-centrality Parameter (NCP)              0.0
 90 Percent Confidence Interval for NCP                (0.0 ; 4.383)

 Minimum Fit Function Value                            0.00277
 Population Discrepancy Function Value (F0)            0.0
 90 Percent Confidence Interval for F0                 (0.0 ; 0.0498)
 Root Mean Square Error of Approximation (RMSEA)       0.0
 90 Percent Confidence Interval for RMSEA              (0.0 ; 0.223)
 P-Value for Test of Close Fit (RMSEA < 0.05)          0.658

 Expected Cross-Validation Index (ECVI)                0.216
 90 Percent Confidence Interval for ECVI               (0.216 ; 0.266)
 ECVI for Saturated Model                              0.227
 ECVI for Independence Model                           0.572

 Chi-Square for Independence Model (6 df)              42.368

 Normed Fit Index (NFI)                                0.994
 Non-Normed Fit Index (NNFI)                           1.125
 Parsimony Normed Fit Index (PNFI)                     0.166
 Comparative Fit Index (CFI)                           1.000
 Incremental Fit Index (IFI)                           1.018
 Relative Fit Index (RFI)                              0.965

 Critical N (CN)                                    2368.235


 Root Mean Square Residual (RMR)                       0.00859
 Standardized RMR                                      0.0138
 Goodness of Fit Index (GFI)                           0.999
 Adjusted Goodness of Fit Index (AGFI)                 0.986
 Parsimony Goodness of Fit Index (PGFI)                0.0999

 !TAM

        Fitted Covariance Matrix

           AVEUSEFU   AVESCORE   AVEINTEN    AVEEASY
           --------   --------   --------   --------
 AVEUSEFU      0.431
 AVESCORE      0.103      0.896
 AVEINTEN      0.226      0.259      0.768
  AVEEASY      0.142      0.184      0.186      0.444

        Fitted Residuals

           AVEUSEFU   AVESCORE   AVEINTEN    AVEEASY
```

```
            --------   --------   --------   --------
AVEUSEFU       - -
AVESCORE      0.027      0.000
AVEINTEN      0.000      0.000       - -
 AVEEASY       - -       0.000      0.000       - -

Summary Statistics for Fitted Residuals

Smallest Fitted Residual =    0.000
  Median Fitted Residual =    0.000
 Largest Fitted Residual =    0.027

Stemleaf Plot

  0|000000000
  1|
  2|7

        Standardized Residuals

           AVEUSEFU   AVESCORE   AVEINTEN    AVEEASY
           --------   --------   --------   --------
AVEUSEFU       - -
AVESCORE      0.494      0.000
AVEINTEN      0.000      0.000       - -
 AVEEASY       - -       0.000      0.000       - -

Summary Statistics for Standardized Residuals

Smallest Standardized Residual =    0.000
  Median Standardized Residual =    0.000
 Largest Standardized Residual =    0.494

Stemleaf Plot

  0|000000000
  1|
  2|
  3|
  4|9

!TAM

Modification Indices and Expected Change

        Modification Indices for BETA

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
AVEUSEFU       - -      0.241       - -
AVESCORE      0.241       - -       - -
AVEINTEN       - -      0.241       - -

        Expected Change for BETA

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
AVEUSEFU       - -      0.039       - -
AVESCORE      0.079       - -       - -
AVEINTEN       - -     -0.146       - -

        Standardized Expected Change for BETA

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
AVEUSEFU       - -      0.063       - -
AVESCORE      0.126       - -       - -
AVEINTEN       - -     -0.176       - -

No Non-Zero Modification Indices for GAMMA

No Non-Zero Modification Indices for PHI

        Modification Indices for PSI

           AVEUSEFU   AVESCORE   AVEINTEN
```

```
            --------   --------   --------
AVEUSEFU       - -
AVESCORE      0.241       - -
AVEINTEN       - -       0.241       - -

        Expected Change for PSI

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
AVEUSEFU       - -
AVESCORE      0.030       - -
AVEINTEN       - -      -0.112       - -

        Standardized Expected Change for PSI

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
AVEUSEFU       - -
AVESCORE      0.049       - -
AVEINTEN       - -      -0.135       - -

        Modification Indices for THETA-EPS

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
AVEUSEFU       - -
AVESCORE      0.241       - -
AVEINTEN      0.241      0.241      0.241

        Expected Change for THETA-EPS

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
AVEUSEFU       - -
AVESCORE      0.027       - -
AVEINTEN     -0.103     -0.112      0.425

        Modification Indices for THETA-DELTA-EPS

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
 AVEEASY      0.241      0.241      0.241

        Expected Change for THETA-DELTA-EPS

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
 AVEEASY     -0.089     -0.124      0.206

Maximum Modification Index is    0.24 for Element ( 3, 1) of THETA-EPS

!TAM

Standardized Solution

        BETA

           AVEUSEFU   AVESCORE   AVEINTEN
           --------   --------   --------
AVEUSEFU       - -        - -        - -
AVESCORE       - -        - -      0.245
AVEINTEN      0.324       - -        - -

        GAMMA

            AVEEASY
            --------
AVEUSEFU      0.325
AVESCORE      0.214
AVEINTEN      0.213

        Correlation Matrix of Y and X

           AVEUSEFU   AVESCORE   AVEINTEN    AVEEASY
           --------   --------   --------   --------
AVEUSEFU      1.000
```

AVESCORE	0.166	1.000		
AVEINTEN	0.393	0.313	1.000	
AVEEASY	0.325	0.292	0.318	1.000

PSI
Note: This matrix is diagonal.

AVEUSEFU	AVESCORE	AVEINTEN
0.894	0.861	0.805

Regression Matrix Y on X (Standardized)

	AVEEASY
AVEUSEFU	0.325
AVESCORE	0.292
AVEINTEN	0.318

!TAM

Total and Indirect Effects

Total Effects of X on Y

	AVEEASY
AVEUSEFU	0.320
	(0.099)
	3.222
AVESCORE	0.415
	(0.145)
	2.868
AVEINTEN	0.419
	(0.133)
	3.150

Indirect Effects of X on Y

	AVEEASY
AVEUSEFU	- -
AVESCORE	0.111
	(0.059)
	1.881
AVEINTEN	0.138
	(0.061)
	2.272

Total Effects of Y on Y

	AVEUSEFU	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	- -
AVESCORE	0.114	- -	0.264
	(0.060)		(0.113)
	1.892		2.344
AVEINTEN	0.432	- -	- -
	(0.135)		
	3.205		

Largest Eigenvalue of B*B' (Stability Index) is 0.187

Indirect Effects of Y on Y

AVEUSEFU	AVESCORE	AVEINTEN

AVEUSEFU	- -	- -	- -
AVESCORE	0.114	- -	- -
	(0.060)		
	1.892		
AVEINTEN	- -	- -	- -

!TAM

Standardized Total and Indirect Effects

Standardized Total Effects of X on Y

	AVEEASY
AVEUSEFU	0.325
AVESCORE	0.292
AVEINTEN	0.318

Standardized Indirect Effects of X on Y

	AVEEASY
AVEUSEFU	- -
AVESCORE	0.078
AVEINTEN	0.105

Standardized Total Effects of Y on Y

	AVEUSEFU	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	- -
AVESCORE	0.079	- -	0.245
AVEINTEN	0.324	- -	- -

Standardized Indirect Effects of Y on Y

	AVEUSEFU	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	- -
AVESCORE	0.079	- -	- -
AVEINTEN	- -	- -	- -

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Lisrel output for TAM-based influence analysis with external factors

(EXB4 - Playfulness included)

```
!TAM
 Observed Variables
 AVEUSEFUL AVEEASY EXA1-EXA4 DUMMY EXB1-EXB6 AVESCORE AVEINTENT
 Covariance Matrix from file TAM.cov
 Sample size = 88
 Relationships
 AVEEASY =  EXB4 EXB6
 AVEUSEFUL = AVEEASY EXA3 EXA4
 AVEINTENT = AVEUSEFUL EXB4
 AVESCORE = AVEEASY AVEINTENT
 !Show output as full Lisrel output
 Lisrel output rs sc mi ef
 Path Diagram
 End of Problem

 !TAM

        Covariance Matrix

            AVEUSEFU    AVEEASY   AVESCORE   AVEINTEN       EXA3       EXA4
            --------    --------  --------   --------   --------   --------
 AVEUSEFU      0.431
  AVEEASY      0.142      0.444
 AVESCORE      0.130      0.184      0.896
 AVEINTEN      0.226      0.185      0.260      0.767
     EXA3      0.312      0.125      0.105      0.265      0.621
     EXA4      0.271      0.119      0.125      0.196      0.354      0.516
     EXB4      0.162      0.258      0.027      0.353      0.213      0.159
     EXB6      0.181      0.210      0.209      0.143      0.119      0.115

        Covariance Matrix

                EXB4       EXB6
            --------   --------
     EXB4      0.692
     EXB6      0.318      0.697

 Total Variance = 5.063 Generalized Variance = 0.00167

 Largest Eigenvalue = 2.029 Smallest Eigenvalue = 0.161

 Condition Number = 3.549


 !TAM

 Parameter Specifications

        BETA

            AVEUSEFU    AVEEASY   AVESCORE   AVEINTEN
            --------    --------  --------   --------
 AVEUSEFU          0          1          0          0
  AVEEASY          0          0          0          0
 AVESCORE          0          2          0          3
 AVEINTEN          4          0          0          0

        GAMMA

                EXA3       EXA4       EXB4       EXB6
            --------   --------   --------   --------
 AVEUSEFU          5          6          0          0
  AVEEASY          0          0          7          8
 AVESCORE          0          0          0          0
 AVEINTEN          0          0          9          0

        PHI

                EXA3       EXA4       EXB4       EXB6
            --------   --------   --------   --------
     EXA3         10
     EXA4         11         12
     EXB4         13         14         15
     EXB6         16         17         18         19

        PSI
```

AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
20	21	22	23

!TAM

Number of Iterations = 9

LISREL Estimates (Maximum Likelihood)

BETA

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	0.158	- -	- -
		(0.081)		
		1.957		
AVEEASY	- -	- -	- -	- -
AVESCORE	- -	0.305	- -	0.265
		(0.149)		(0.114)
		2.046		2.331
AVEINTEN	0.365	- -	- -	- -
	(0.128)			
	2.858			

GAMMA

	EXA3	EXA4	EXB4	EXB6
AVEUSEFU	0.315	0.274	- -	- -
	(0.087)	(0.095)		
	3.642	2.894		
AVEEASY	- -	- -	0.296	0.167
			(0.085)	(0.085)
			3.484	1.968
AVESCORE	- -	- -	- -	- -
AVEINTEN	- -	- -	0.425	- -
			(0.100)	
			4.258	

Covariance Matrix of Y and X

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN	EXA3	EXA4
AVEUSEFU	0.422					
AVEEASY	0.114	0.444				
AVESCORE	0.093	0.175	0.890			
AVEINTEN	0.219	0.151	0.248	0.763		
EXA3	0.306	0.083	0.079	0.202	0.621	
EXA4	0.263	0.066	0.064	0.164	0.354	0.516
EXB4	0.151	0.258	0.171	0.349	0.213	0.159
EXB6	0.102	0.210	0.110	0.173	0.119	0.115

Covariance Matrix of Y and X

	EXB4	EXB6
EXB4	0.692	
EXB6	0.318	0.697

PHI

	EXA3	EXA4	EXB4	EXB6
EXA3	0.621			

	(0.096)			
	6.481			
EXA4	0.354	0.516		
	(0.073)	(0.080)		
	4.857	6.481		
EXB4	0.213	0.159	0.692	
	(0.075)	(0.067)	(0.107)	
	2.827	2.360	6.481	
EXB6	0.119	0.115	0.318	0.697
	(0.073)	(0.067)	(0.083)	(0.108)
	1.634	1.729	3.815	6.481

PSI

Note: This matrix is diagonal.

AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
0.236	0.332	0.771	0.534
(0.036)	(0.051)	(0.119)	(0.082)
6.481	6.481	6.481	6.481

Squared Multiple Correlations for Structural Equations

AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
0.441	0.251	0.134	0.300

NOTE: Rm for Structural Equatios are Hayduk's (2006) Blocked-Error Rm

Reduced Form

	EXA3	EXA4	EXB4	EXB6
AVEUSEFU	0.315	0.274	0.047	0.026
	(0.087)	(0.095)	(0.028)	(0.019)
	3.620	2.877	1.696	1.379
AVEEASY	- -	- -	0.296	0.167
			(0.086)	(0.085)
			3.463	1.957
AVESCORE	0.030	0.027	0.207	0.053
	(0.019)	(0.017)	(0.069)	(0.037)
	1.609	1.523	2.994	1.448
AVEINTEN	0.115	0.100	0.442	0.010
	(0.051)	(0.050)	(0.099)	(0.008)
	2.235	2.021	4.447	1.241

Squared Multiple Correlations for Reduced Form

AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
0.422	0.251	0.051	0.257

Log-likelihood Values

	Estimated Model	Saturated Model
Number of free parameters(t)	23	36
-2ln(L)	162.196	141.070
AIC (Akaike, 1974)*	208.196	213.070
BIC (Schwarz, 1978)*	265.175	302.254

*LISREL uses AIC= 2t - 2ln(L) and BIC = tln(N)- 2ln(L)

Goodness-of-Fit Statistics

Degrees of Freedom for (C1)-(C2) 13

```
Maximum Likelihood Ratio Chi-Square (C1)              21.126 (P = 0.0705)
Browne's (1984) ADF Chi-Square (C2_NT)                20.552 (P = 0.0823)

Estimated Non-centrality Parameter (NCP)              8.126
90 Percent Confidence Interval for NCP                (0.0 ; 24.808)

Minimum Fit Function Value                            0.240
Population Discrepancy Function Value (F0)            0.0923
90 Percent Confidence Interval for F0                 (0.0 ; 0.282)
Root Mean Square Error of Approximation (RMSEA)       0.0843
90 Percent Confidence Interval for RMSEA              (0.0 ; 0.147)
P-Value for Test of Close Fit (RMSEA < 0.05)          0.183

Expected Cross-Validation Index (ECVI)                0.763
90 Percent Confidence Interval for ECVI               (0.670 ; 0.952)
ECVI for Saturated Model                              0.818
ECVI for Independence Model                           2.682

Chi-Square for Independence Model (28 df)           219.992

Normed Fit Index (NFI)                                0.904
Non-Normed Fit Index (NNFI)                           0.909
Parsimony Normed Fit Index (PNFI)                     0.420
Comparative Fit Index (CFI)                           0.958
Incremental Fit Index (IFI)                           0.961
Relative Fit Index (RFI)                              0.793

Critical N (CN)                                     115.029


Root Mean Square Residual (RMR)                       0.0393
Standardized RMR                                      0.0588
Goodness of Fit Index (GFI)                           0.945
Adjusted Goodness of Fit Index (AGFI)                 0.847
Parsimony Goodness of Fit Index (PGFI)                0.341

!TAM

        Fitted Covariance Matrix

           AVEUSEFU    AVEEASY   AVESCORE   AVEINTEN       EXA3       EXA4
           --------    --------   --------   --------   --------   --------
AVEUSEFU      0.422
 AVEEASY      0.114      0.444
AVESCORE      0.093      0.175      0.890
AVEINTEN      0.219      0.151      0.248      0.763
    EXA3      0.306      0.083      0.079      0.202      0.621
    EXA4      0.263      0.066      0.064      0.164      0.354      0.516
    EXB4      0.151      0.258      0.171      0.349      0.213      0.159
    EXB6      0.102      0.210      0.110      0.173      0.119      0.115

        Fitted Covariance Matrix

              EXB4       EXB6
           --------   --------
    EXB4      0.692
    EXB6      0.318      0.697

        Fitted Residuals

           AVEUSEFU    AVEEASY   AVESCORE   AVEINTEN       EXA3       EXA4
           --------    --------   --------   --------   --------   --------
AVEUSEFU      0.009
 AVEEASY      0.028      - -
AVESCORE      0.037      0.009      0.006
AVEINTEN      0.008      0.034      0.012      0.004
    EXA3      0.007      0.042      0.026      0.063      - -
    EXA4      0.008      0.053      0.061      0.032      - -      - -
    EXB4      0.010      - -     -0.144      0.004      0.000      0.000
    EXB6      0.079      0.000      0.099     -0.029      0.000      0.000

        Fitted Residuals

              EXB4       EXB6
           --------   --------
    EXB4      - -
```

```
    EXB6       - -        - -

Summary Statistics for Fitted Residuals

Smallest Fitted Residual =   -0.144
  Median Fitted Residual =    0.006
 Largest Fitted Residual =    0.099

Stemleaf Plot

-14|4
-12|
-10|
- 8|
- 6|
- 4|
- 2|9
- 0|0000000000000
  0|4467889902
  2|68247
  4|23
  6|139
  8|9

        Standardized Residuals

           AVEUSEFU    AVEEASY   AVESCORE   AVEINTEN      EXA3       EXA4
           --------   --------   --------   --------   --------   --------
AVEUSEFU      0.153
 AVEEASY      0.618       - -
AVESCORE      0.650      0.136      0.044
AVEINTEN      0.130      0.563      0.139      0.044
    EXA3      0.106      0.935      0.336      0.895       - -
    EXA4      0.231      1.107      0.879      0.480       - -       - -
    EXB4      0.206       - -      -2.139      0.046      0.000      0.000
    EXB6      1.470      0.000      1.722     -0.395      0.000      0.000

        Standardized Residuals

              EXB4       EXB6
           --------   --------
    EXB4       - -
    EXB6       - -        - -

Summary Statistics for Standardized Residuals

Smallest Standardized Residual =   -2.139
  Median Standardized Residual =    0.076
 Largest Standardized Residual =    1.722

Stemleaf Plot

- 2|1
- 1|
- 1|
- 0|
- 0|400000000000000000
  0|11112223
  0|5667999
  1|1
  1|57

!TAM

                    Qplot of Standardized Residuals

 3.5.....................................................................
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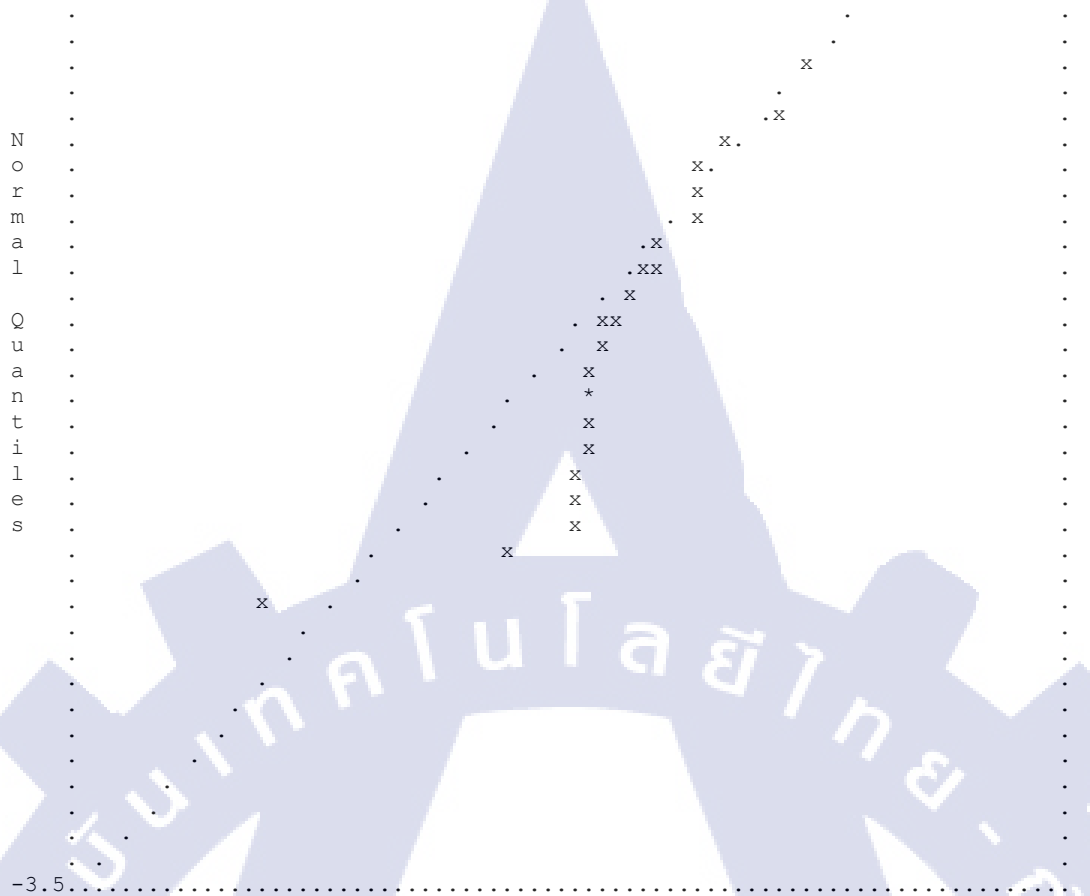


!TAM

Modification Indices and Expected Change

Modification Indices for BETA

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	0.059	0.860
AVEEASY	0.174	- -	1.593	0.676
AVESCORE	0.237	- -	- -	- -
AVEINTEN	- -	0.272	2.546	- -

Expected Change for BETA

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	0.015	-0.088
AVEEASY	0.058	- -	0.173	0.069
AVESCORE	0.078	- -	- -	- -
AVEINTEN	- -	0.070	0.265	- -

Standardized Expected Change for BETA

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	0.024	-0.155
AVEEASY	0.134	- -	0.275	0.118
AVESCORE	0.127	- -	- -	- -
AVEINTEN	- -	0.121	0.321	- -

Modification Indices for GAMMA

	EXA3	EXA4	EXB4	EXB6
AVEUSEFU	- -	- -	0.082	3.968
AVEEASY	0.851	1.518	- -	- -
AVESCORE	0.002	0.314	5.326	2.199

AVEINTEN	1.560	0.408	- -	0.999

Expected Change for GAMMA

	EXA3	EXA4	EXB4	EXB6
AVEUSEFU	- -	- -	0.021	0.136
AVEEASY	0.077	0.110	- -	- -
AVESCORE	-0.006	0.076	-0.325	0.183
AVEINTEN	0.158	0.085	- -	-0.106

Standardized Expected Change for GAMMA

	EXA3	EXA4	EXB4	EXB6
AVEUSEFU	- -	- -	0.027	0.175
AVEEASY	0.091	0.119	- -	- -
AVESCORE	-0.005	0.058	-0.287	0.162
AVEINTEN	0.143	0.070	- -	-0.101

No Non-Zero Modification Indices for PHI

Modification Indices for PSI

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -			
AVEEASY	1.282	- -		
AVESCORE	0.163	1.009	- -	
AVEINTEN	1.673	0.561	2.281	- -

Expected Change for PSI

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -			
AVEEASY	-0.071	- -		
AVESCORE	0.019	0.118	- -	
AVEINTEN	-0.078	0.034	0.208	- -

Standardized Expected Change for PSI

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -			
AVEEASY	-0.164	- -		
AVESCORE	0.031	0.188	- -	
AVEINTEN	-0.138	0.059	0.253	- -

Modification Indices for THETA-EPS

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	1.673			
AVEEASY	1.930	0.032		
AVESCORE	0.042	0.657	- -	
AVEINTEN	1.655	0.401	2.281	2.281

Expected Change for THETA-EPS

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	0.215			
AVEEASY	-0.072	0.049		
AVESCORE	0.009	0.091	- -	
AVEINTEN	-0.073	0.028	0.208	-0.787

Modification Indices for THETA-DELTA-EPS

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
EXA3	0.991	0.225	0.029	1.258
EXA4	0.660	0.813	0.324	0.011
EXB4	0.000	0.016	8.460	0.897
EXB6	4.945	10.396	5.058	2.636

Expected Change for THETA-DELTA-EPS

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
EXA3	-0.097	0.017	-0.009	0.048
EXA4	-0.086	0.030	0.028	0.004
EXB4	-0.001	0.009	-0.170	0.083
EXB6	0.081	-0.504	0.153	-0.090

Maximum Modification Index is 10.40 for Element (4, 2) of THETA DELTA-EPSILON

!TAM

Standardized Solution

BETA

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	0.162	- -	- -
AVEEASY	- -	- -	- -	- -
AVESCORE	- -	0.215	- -	0.245
AVEINTEN	0.272	- -	- -	- -

GAMMA

	EXA3	EXA4	EXB4	EXB6
AVEUSEFU	0.382	0.303	- -	- -
AVEEASY	- -	- -	0.370	0.209
AVESCORE	- -	- -	- -	- -
AVEINTEN	- -	- -	0.405	- -

Correlation Matrix of Y and X

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN	EXA3	EXA4
AVEUSEFU	1.000					
AVEEASY	0.264	1.000				
AVESCORE	0.151	0.279	1.000			
AVEINTEN	0.385	0.260	0.301	1.000		
EXA3	0.597	0.158	0.106	0.294	1.000	
EXA4	0.564	0.139	0.094	0.261	0.625	1.000
EXB4	0.280	0.466	0.218	0.481	0.324	0.267
EXB6	0.189	0.378	0.139	0.237	0.181	0.192

Correlation Matrix of Y and X

	EXB4	EXB6
EXB4	1.000	
EXB6	0.458	1.000

PSI

Note: This matrix is diagonal.

AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
0.559	0.749	0.866	0.700

Regression Matrix Y on X (Standardized)

	EXA3	EXA4	EXB4	EXB6
AVEUSEFU	0.382	0.303	0.060	0.034
AVEEASY	- -	- -	0.370	0.209
AVESCORE	0.025	0.020	0.183	0.047
AVEINTEN	0.104	0.082	0.421	0.009

!TAM

Total and Indirect Effects

Total Effects of X on Y

EXA3	EXA4	EXB4	EXB6

AVEUSEFU	0.315	0.274	0.047	0.026
	(0.085)	(0.092)	(0.027)	(0.019)
	3.727	2.962	1.746	1.420
AVEEASY	- -	- -	0.296	0.167
			(0.083)	(0.083)
			3.566	2.015
AVESCORE	0.030	0.027	0.207	0.053
	(0.018)	(0.017)	(0.067)	(0.036)
	1.656	1.568	3.083	1.491
AVEINTEN	0.115	0.100	0.442	0.010
	(0.050)	(0.048)	(0.097)	(0.008)
	2.301	2.081	4.579	1.278

Indirect Effects of X on Y

	EXA3	EXA4	EXB4	EXB6
AVEUSEFU	- -	- -	0.047	0.026
			(0.027)	(0.019)
			1.746	1.420
AVEEASY	- -	- -	- -	- -
AVESCORE	0.030	0.027	0.207	0.053
	(0.018)	(0.017)	(0.067)	(0.036)
	1.656	1.568	3.083	1.491
AVEINTEN	0.115	0.100	0.017	0.010
	(0.050)	(0.048)	(0.011)	(0.008)
	2.301	2.081	1.499	1.278

Total Effects of Y on Y

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	0.158	- -	- -
		(0.079)		
		2.003		
AVEEASY	- -	- -	- -	- -
AVESCORE	0.097	0.320	- -	0.265
	(0.052)	(0.144)		(0.111)
	1.849	2.218		2.386
AVEINTEN	0.365	0.058	- -	- -
	(0.125)	(0.035)		
	2.925	1.652		

Largest Eigenvalue of B*B' (Stability Index) is 0.178

Indirect Effects of Y on Y

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	- -	- -
AVEEASY	- -	- -	- -	- -
AVESCORE	0.097	0.015	- -	- -
	(0.052)	(0.011)		
	1.849	1.359		
AVEINTEN	- -	0.058	- -	- -
		(0.035)		
		1.652		

!TAM

Standardized Total and Indirect Effects

Standardized Total Effects of X on Y

	EXA3	EXA4	EXB4	EXB6
AVEUSEFU	0.382	0.303	0.060	0.034
AVEEASY	- -	- -	0.370	0.209
AVESCORE	0.025	0.020	0.183	0.047
AVEINTEN	0.104	0.082	0.421	0.009

Standardized Indirect Effects of X on Y

	EXA3	EXA4	EXB4	EXB6
AVEUSEFU	- -	- -	0.060	0.034
AVEEASY	- -	- -	- -	- -
AVESCORE	0.025	0.020	0.183	0.047
AVEINTEN	0.104	0.082	0.016	0.009

Standardized Total Effects of Y on Y

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	0.162	- -	- -
AVEEASY	- -	- -	- -	- -
AVESCORE	0.067	0.226	- -	0.245
AVEINTEN	0.272	0.044	- -	- -

Standardized Indirect Effects of Y on Y

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	- -	- -
AVEEASY	- -	- -	- -	- -
AVESCORE	0.067	0.011	- -	- -
AVEINTEN	- -	0.044	- -	- -

ภาคผนวก ง.

Lisrel output for TAM-based influence analysis with external factors

(EXB5 - Enjoyment included)

```
!TAM
 Observed Variables
 AVEUSEFUL AVEEASY EXA1-EXA4 DUMMY EXB1-EXB6 AVESCORE AVEINTENT
 Covariance Matrix from file TAM.cov
 Sample size = 88
 Relationships
 AVEEASY =  EXB6
 !EXB5 = AVEEASY
 AVEUSEFUL = AVEEASY EXA3 EXA4
 AVEINTENT = AVEUSEFUL EXB5 AVEEASY
 AVESCORE = AVEEASY AVEINTENT
 !Show output as full Lisrel output
 Lisrel output rs sc mi ef
 Path Diagram
 End of Problem

 !TAM

        Covariance Matrix

            AVEUSEFU    AVEEASY   AVESCORE   AVEINTEN       EXA3       EXA4
            --------    --------   --------   --------   --------   --------
 AVEUSEFU       0.431
  AVEEASY       0.142      0.444
 AVESCORE       0.130      0.184      0.896
 AVEINTEN       0.226      0.185      0.260      0.767
     EXA3       0.312      0.125      0.105      0.265      0.621
     EXA4       0.271      0.119      0.125      0.196      0.354      0.516
     EXB5       0.145      0.243      0.060      0.296      0.232      0.148
     EXB6       0.181      0.210      0.209      0.143      0.119      0.115

        Covariance Matrix

                EXB5       EXB6
            --------   --------
     EXB5       0.814
     EXB6       0.368      0.697

 Total Variance = 5.185 Generalized Variance = 0.00227

 Largest Eigenvalue = 2.048 Smallest Eigenvalue = 0.163

 Condition Number = 3.542


 !TAM

 Parameter Specifications

        BETA

            AVEUSEFU    AVEEASY   AVESCORE   AVEINTEN
            --------   --------   --------   --------
 AVEUSEFU          0          1          0          0
  AVEEASY          0          0          0          0
 AVESCORE          0          2          0          3
 AVEINTEN          4          5          0          0

        GAMMA

                EXA3       EXA4       EXB5       EXB6
            --------   --------   --------   --------
 AVEUSEFU          6          7          0          0
  AVEEASY          0          0          0          8
 AVESCORE          0          0          0          0
 AVEINTEN          0          0          9          0

        PHI

                EXA3       EXA4       EXB5       EXB6
            --------   --------   --------   --------
     EXA3         10
     EXA4         11         12
     EXB5         13         14         15
     EXB6         16         17         18         19
```

PSI

AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
20	21	22	23

!TAM

Number of Iterations = 11

LISREL Estimates (Maximum Likelihood)

BETA

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	0.158	- -	- -
		(0.080)		
		1.978		
AVEEASY	- -	- -	- -	- -
AVESCORE	- -	0.305	- -	0.265
		(0.148)		(0.114)
		2.061		2.323
AVEINTEN	0.390	0.157	- -	- -
	(0.134)	(0.129)		
	2.904	1.225		

GAMMA

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	0.315	0.274	- -	- -
	(0.086)	(0.095)		
	3.655	2.896		
AVEEASY	- -	- -	- -	0.302
				(0.081)
				3.746
AVESCORE	- -	- -	- -	- -
AVEINTEN	- -	- -	0.247	- -
			(0.095)	
			2.595	

Covariance Matrix of Y and X

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN	EXA3	EXA4
AVEUSEFU	0.415					
AVEEASY	0.091	0.444				
AVESCORE	0.083	0.170	0.886			
AVEINTEN	0.208	0.133	0.238	0.745		
EXA3	0.298	0.036	0.058	0.179	0.621	
EXA4	0.258	0.035	0.048	0.143	0.354	0.516
EXB5	0.131	0.111	0.105	0.270	0.232	0.148
EXB6	0.102	0.210	0.108	0.164	0.119	0.115

Covariance Matrix of Y and X

	EXB5	EXB6
EXB5	0.814	
EXB6	0.368	0.697

PHI

EXA3	EXA4	EXB5	EXB6

EXA3	0.621			
	(0.096)			
	6.481			
EXA4	0.354	0.516		
	(0.073)	(0.080)		
	4.857	6.481		
EXB5	0.232	0.148	0.814	
	(0.082)	(0.073)	(0.126)	
	2.847	2.045	6.481	
EXB6	0.119	0.115	0.368	0.697
	(0.073)	(0.067)	(0.091)	(0.108)
	1.634	1.729	4.027	6.481

PSI
Note: This matrix is diagonal.

AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
0.236	0.380	0.771	0.576
(0.036)	(0.059)	(0.119)	(0.089)
6.481	6.481	6.481	6.481

Squared Multiple Correlations for Structural Equations

AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
0.431	0.143	0.130	0.227

NOTE: R² for Structural Equatios are Hayduk's (2006) Blocked-Error R²

Reduced Form

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	0.315	0.274	- -	0.048
	(0.087)	(0.095)		(0.027)
	3.634	2.879		1.739
AVEEASY	- -	- -	- -	0.302
				(0.081)
				3.724
AVESCORE	0.033	0.028	0.065	0.110
	(0.020)	(0.019)	(0.038)	(0.054)
	1.615	1.528	1.720	2.037
AVEINTEN	0.123	0.107	0.247	0.066
	(0.054)	(0.052)	(0.096)	(0.043)
	2.260	2.038	2.580	1.524

Squared Multiple Correlations for Reduced Form

AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
0.409	0.143	0.025	0.154

Log-likelihood Values

	Estimated Model	Saturated Model
Number of free parameters(t)	23	36
-2ln(L)	191.808	168.445
AIC (Akaike, 1974)*	237.808	240.445
BIC (Schwarz, 1978)*	294.786	329.630

*LISREL uses AIC= 2t - 2ln(L) and BIC = tln(N)- 2ln(L)

Goodness-of-Fit Statistics

```
Degrees of Freedom for (C1)-(C2)                    13
Maximum Likelihood Ratio Chi-Square (C1)            23.362 (P = 0.0375)
Browne's (1984) ADF Chi-Square (C2_NT)              23.570 (P = 0.0353)

Estimated Non-centrality Parameter (NCP)            10.362
90 Percent Confidence Interval for NCP              (0.588 ; 27.937)

Minimum Fit Function Value                          0.265
Population Discrepancy Function Value (F0)          0.118
90 Percent Confidence Interval for F0               (0.00668 ; 0.317)
Root Mean Square Error of Approximation (RMSEA)     0.0952
90 Percent Confidence Interval for RMSEA            (0.0227 ; 0.156)
P-Value for Test of Close Fit (RMSEA < 0.05)        0.116

Expected Cross-Validation Index (ECVI)              0.788
90 Percent Confidence Interval for ECVI             (0.677 ; 0.988)
ECVI for Saturated Model                            0.818
ECVI for Independence Model                         2.533

Chi-Square for Independence Model (28 df)         206.923

Normed Fit Index (NFI)                              0.887
Non-Normed Fit Index (NNFI)                         0.875
Parsimony Normed Fit Index (PNFI)                   0.412
Comparative Fit Index (CFI)                         0.942
Incremental Fit Index (IFI)                         0.947
Relative Fit Index (RFI)                            0.757

Critical N (CN)                                   104.114


Root Mean Square Residual (RMR)                     0.0473
Standardized RMR                                    0.0794
Goodness of Fit Index (GFI)                         0.937
Adjusted Goodness of Fit Index (AGFI)               0.826
Parsimony Goodness of Fit Index (PGFI)              0.338

!TAM

        Fitted Covariance Matrix

           AVEUSEFU    AVEEASY   AVESCORE   AVEINTEN       EXA3       EXA4
           --------   --------   --------   --------   --------   --------
AVEUSEFU      0.415
 AVEEASY      0.091      0.444
AVESCORE      0.083      0.170      0.886
AVEINTEN      0.208      0.133      0.238      0.745
    EXA3      0.298      0.036      0.058      0.179      0.621
    EXA4      0.258      0.035      0.048      0.143      0.354      0.516
    EXB5      0.131      0.111      0.105      0.270      0.232      0.148
    EXB6      0.102      0.210      0.108      0.164      0.119      0.115

        Fitted Covariance Matrix

              EXB5       EXB6
           --------   --------
    EXB5      0.814
    EXB6      0.368      0.697

        Fitted Residuals

           AVEUSEFU    AVEEASY   AVESCORE   AVEINTEN       EXA3       EXA4
           --------   --------   --------   --------   --------   --------
AVEUSEFU      0.016
 AVEEASY      0.051      0.000
AVESCORE      0.047      0.014      0.010
AVEINTEN      0.018      0.053      0.022      0.022
    EXA3      0.014      0.089      0.047      0.086      - -
    EXA4      0.013      0.084      0.076      0.054      - -        - -
    EXB5      0.014      0.132     -0.045      0.026      0.000      - -
    EXB6      0.079      - -        0.101     -0.021      0.000      0.000

        Fitted Residuals

              EXB5       EXB6
           --------   --------
```

```
    EXB5       - -
    EXB6       - -        - -

Summary Statistics for Fitted Residuals

Smallest Fitted Residual =   -0.045
  Median Fitted Residual =    0.014
 Largest Fitted Residual =    0.132

Stemleaf Plot

- 4|5
- 2|1
- 0|000000000000
  0|0344468
  2|226
  4|77134
  6|69
  8|469
 10|1
 12|2
```

Standardized Residuals

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN	EXA3	EXA4
AVEUSEFU	0.267					
AVEEASY	1.177	0.000				
AVESCORE	0.796	0.204	0.076			
AVEINTEN	0.339	0.911	0.252	0.224		
EXA3	0.227	1.976	0.600	1.122	- -	
EXA4	0.332	1.754	1.080	0.797	- -	- -
EXB5	0.242	2.036	-0.565	0.309	0.000	- -
EXB6	1.476	- -	1.774	-0.269	0.000	0.000

Standardized Residuals

	EXB5	EXB6
EXB5	- -	
EXB6	- -	- -

```
Summary Statistics for Standardized Residuals

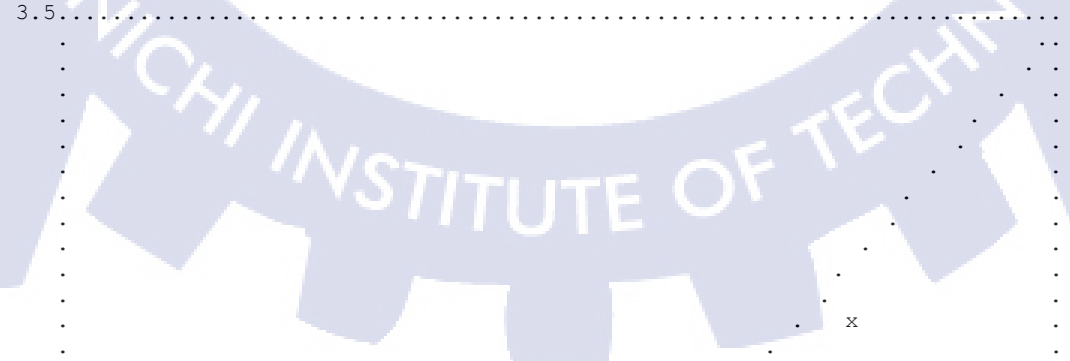
Smallest Standardized Residual =   -0.565
  Median Standardized Residual =    0.235
 Largest Standardized Residual =    2.036

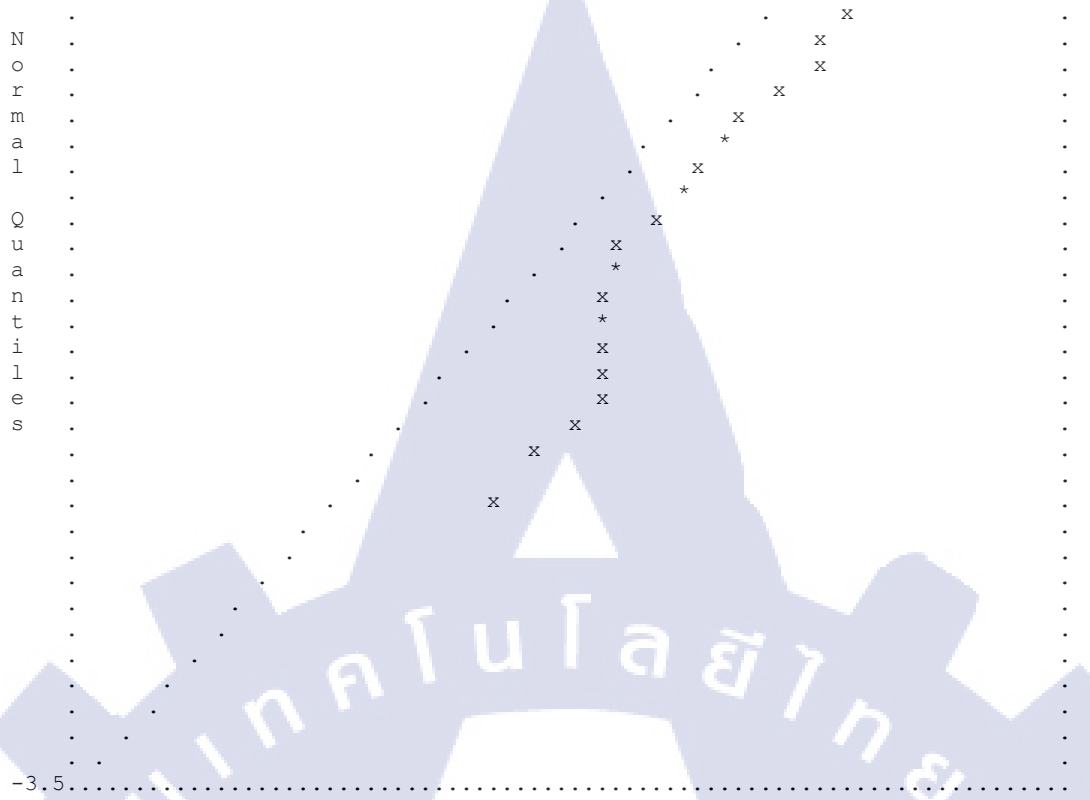
Stemleaf Plot

- 0|6
- 0|3000000000000
  0|1222233333
  0|6889
  1|112
  1|588
  2|00

!TAM
```

Qplot of Standardized Residuals





!TAM

Modification Indices and Expected Change

Modification Indices for BETA

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	0.045	1.452
AVEEASY	0.912	- -	0.534	5.422
AVESCORE	0.235	- -	- -	- -
AVEINTEN	- -	- -	0.161	- -

Expected Change for BETA

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	0.013	-0.122
AVEEASY	0.146	- -	-0.141	0.403
AVESCORE	0.077	- -	- -	- -
AVEINTEN	- -	- -	0.087	- -

Standardized Expected Change for BETA

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	0.021	-0.220
AVEEASY	0.340	- -	-0.224	0.700
AVESCORE	0.127	- -	- -	- -
AVEINTEN	- -	- -	0.107	- -

Modification Indices for GAMMA

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	- -	- -	0.025	4.016
AVEEASY	3.041	3.260	6.452	- -
AVESCORE	0.002	0.307	1.355	2.200
AVEINTEN	1.753	0.535	- -	0.850

Expected Change for GAMMA

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	- -	- -	-0.010	0.138
AVEEASY	0.149	0.169	0.213	- -
AVESCORE	-0.006	0.075	-0.130	0.183
AVEINTEN	0.175	0.101	- -	-0.110

Standardized Expected Change for GAMMA

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	- -	- -	-0.014	0.178
AVEEASY	0.176	0.183	0.289	- -
AVESCORE	-0.005	0.057	-0.125	0.162
AVEINTEN	0.160	0.084	- -	-0.106

No Non-Zero Modification Indices for PHI

Modification Indices for PSI

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -			
AVEEASY	4.016	- -		
AVESCORE	0.164	2.200	- -	
AVEINTEN	1.558	0.850	0.161	- -

Expected Change for PSI

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -			
AVEEASY	-0.173	- -		
AVESCORE	0.019	-0.230	- -	
AVEINTEN	-0.080	0.138	0.067	- -

Standardized Expected Change for PSI

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -			
AVEEASY	-0.404	- -		
AVESCORE	0.031	-0.367	- -	
AVEINTEN	-0.144	0.240	0.082	- -

Modification Indices for THETA-EPS

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	1.558			
AVEEASY	3.566	3.649		
AVESCORE	0.117	2.837	- -	
AVEINTEN	1.658	2.262	0.161	0.161

Expected Change for THETA-EPS

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	0.205			
AVEEASY	-0.137	0.647		
AVESCORE	0.015	-0.251	- -	
AVEINTEN	-0.077	0.197	0.067	-0.253

Modification Indices for THETA-DELTA-EPS

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
EXA3	0.221	0.191	0.062	1.243
EXA4	1.013	1.145	0.169	0.030
EXB5	0.909	6.546	3.902	1.063
EXB6	6.066	13.472	4.646	1.975

Expected Change for THETA-DELTA-EPS

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN

EXA3	-0.040	0.016	-0.013	0.049
EXA4	-0.105	0.038	0.021	0.007
EXB5	-0.037	0.121	-0.136	0.116
EXB6	0.085	-0.292	0.139	-0.076

Maximum Modification Index is 13.47 for Element (4, 2) of THETA DELTA-EPSILON

!TAM

Standardized Solution

BETA

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	0.163	- -	- -
AVEEASY	- -	- -	- -	- -
AVESCORE	- -	0.216	- -	0.243
AVEINTEN	0.291	0.122	- -	- -

GAMMA

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	0.385	0.305	- -	- -
AVEEASY	- -	- -	- -	0.378
AVESCORE	- -	- -	- -	- -
AVEINTEN	- -	- -	0.258	- -

Correlation Matrix of Y and X

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN	EXA3	EXA4
AVEUSEFU	1.000					
AVEEASY	0.212	1.000				
AVESCORE	0.137	0.272	1.000			
AVEINTEN	0.375	0.231	0.293	1.000		
EXA3	0.587	0.069	0.079	0.263	1.000	
EXA4	0.558	0.073	0.072	0.230	0.625	1.000
EXB5	0.226	0.185	0.124	0.347	0.327	0.229
EXB6	0.190	0.378	0.137	0.228	0.181	0.192

Correlation Matrix of Y and X

	EXB5	EXB6
EXB5	1.000	
EXB6	0.489	1.000

PSI
Note: This matrix is diagonal.

AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
0.569	0.857	0.870	0.773

Regression Matrix Y on X (Standardized)

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	0.385	0.305	- -	0.062
AVEEASY	- -	- -	- -	0.378
AVESCORE	0.027	0.022	0.063	0.097
AVEINTEN	0.112	0.089	0.258	0.064

!TAM

Total and Indirect Effects

Total Effects of X on Y

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	0.315	0.274	- -	0.048
	(0.084)	(0.092)		(0.027)
	3.741	2.964		1.790

AVEEASY	- -	- -	- -	0.302
				(0.079)
				3.835
AVESCORE	0.033	0.028	0.065	0.110
	(0.020)	(0.018)	(0.037)	(0.052)
	1.663	1.573	1.771	2.097
AVEINTEN	0.123	0.107	0.247	0.066
	(0.053)	(0.051)	(0.093)	(0.042)
	2.327	2.099	2.656	1.569

Indirect Effects of X on Y

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	- -	- -	- -	0.048
				(0.027)
				1.790
AVEEASY	- -	- -	- -	- -
AVESCORE	0.033	0.028	0.065	0.110
	(0.020)	(0.018)	(0.037)	(0.052)
	1.663	1.573	1.771	2.097
AVEINTEN	0.123	0.107	- -	0.066
	(0.053)	(0.051)		(0.042)
	2.327	2.099		1.569

Total Effects of Y on Y

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	0.158	- -	- -
		(0.078)		
		2.025		
AVEEASY	- -	- -	- -	- -
AVESCORE	0.103	0.363	- -	0.265
	(0.056)	(0.145)		(0.111)
	1.856	2.505		2.377
AVEINTEN	0.390	0.219	- -	- -
	(0.131)	(0.127)		
	2.972	1.720		

Largest Eigenvalue of B*B' (Stability Index) is 0.231

Indirect Effects of Y on Y

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	- -	- -
AVEEASY	- -	- -	- -	- -
AVESCORE	0.103	0.058	- -	- -
	(0.056)	(0.042)		
	1.856	1.393		
AVEINTEN	- -	0.061	- -	- -
		(0.037)		
		1.673		

!TAM

Standardized Total and Indirect Effects

Standardized Total Effects of X on Y

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	0.385	0.305	- -	0.062
AVEEASY	- -	- -	- -	0.378
AVESCORE	0.027	0.022	0.063	0.097
AVEINTEN	0.112	0.089	0.258	0.064

Standardized Indirect Effects of X on Y

	EXA3	EXA4	EXB5	EXB6
AVEUSEFU	- -	- -	- -	0.062
AVEEASY	- -	- -	- -	- -
AVESCORE	0.027	0.022	0.063	0.097
AVEINTEN	0.112	0.089	- -	0.064

Standardized Total Effects of Y on Y

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	0.163	- -	- -
AVEEASY	- -	- -	- -	- -
AVESCORE	0.071	0.257	- -	0.243
AVEINTEN	0.291	0.169	- -	- -

Standardized Indirect Effects of Y on Y

	AVEUSEFU	AVEEASY	AVESCORE	AVEINTEN
AVEUSEFU	- -	- -	- -	- -
AVEEASY	- -	- -	- -	- -
AVESCORE	0.071	0.041	- -	- -
AVEINTEN	- -	0.047	- -	- -

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บทคัดย่อ

ระบบการวางแผนทรัพยากรองค์กรหรือระบบEnterprise Resource Planning(ERP)เป็นแนวทางหลักที่ใช้ในการบูรณาการข้อมูลทั่วทั้งองค์กรให้อยู่บนฐานข้อมูลเดียวกัน เนื่องด้วยความสำคัญที่เพิ่มขึ้นของระบบERPนี้ ทำให้สถาบันการศึกษาระดับอุดมศึกษาได้จัดให้มีการเรียนการสอนระบบERPในมหาวิทยาลัย เพื่อให้นักศึกษามีความพร้อมในการประกอบอาชีพการงานในอนาคต ในงานวิจัยนี้นักศึกษามหาวิทยาลัยถือว่าเป็นผู้เรียนระบบERPในระดับต้น โดยงานวิจัยนี้มีวัตถุประสงค์เพื่อทำเข้าใจว่าผู้เรียนระดับต้นสามารถยอมรับการใช้ระบบERPได้อย่างไรและเพื่อศึกษาถึงปัจจัยที่มีอิทธิพลต่อความสำเร็จในการเรียนรู้ ผู้วิจัยได้นำตัวแบบการยอมรับเทคโนโลยี(Technology Acceptance Model, TAM)มาประยุกต์ใช้เพื่อวิเคราะห์การยอมรับเทคโนโลยีของผู้เรียนระดับต้น ข้อมูลงานวิจัยถูกรวบรวมอย่างเฉพาะเจาะจงจากนักศึกษาระดับปริญญาตรีจำนวน 88 คนที่ลงทะเบียนเรียนในวิชาERPที่สถาบันเทคโนโลยีไทย-ญี่ปุ่น(TNI) มีการใช้หลักการการวิเคราะห์เส้นทาง(Path analysis)เพื่อวิเคราะห์อิทธิพลจากปัจจัยหลักสองปัจจัยในตัวแบบTAMซึ่งได้แก่การรับรู้ประโยชน์และการรับรู้ความง่าย อิทธิพลจากความตั้งใจที่จะใช้งาน และอิทธิพลจากปัจจัยภายนอก

จากผลการศึกษาได้พบว่า ปัจจัยหลักสองปัจจัยในตัวแบบTAMส่งผลทางบวกต่อความตั้งใจที่จะใช้งานซึ่งแสดงให้เห็นถึงการยอมรับเทคโนโลยี ในด้านความสำเร็จในการเรียนรู้ซึ่งวัดโดยคะแนนการสอบ พบว่าการรับรู้ความง่ายมีผลทางบวกอย่างมีนัยยะสำคัญต่อความสำเร็จในการเรียนรู้ ในขณะที่การรับรู้ประโยชน์ไม่มีผลต่อความสำเร็จในการเรียนรู้โดยตรง แต่มีผลทางอ้อมต่อความสำเร็จในการเรียนรู้โดยผ่านปัจจัยความตั้งใจที่จะใช้งาน

ในด้านอิทธิพลจากปัจจัยภายนอก พบว่าความเกี่ยวข้องสัมพันธ์กับงาน(Job relevance)และคุณภาพของผลลัพธ์(Output quality)มีอิทธิพลทางบวกต่อการรับรู้ประโยชน์ ส่วนความสนุกสนานในการใช้งาน(หรือความเพลิดเพลิน)และความสามารถในการใช้งานอย่างเป็นรูปธรรม(Objective usability)มีอิทธิพลทางบวกต่อการรับรู้ความง่าย นอกจากนี้ความสนุกสนานในการใช้งาน(หรือความเพลิดเพลิน)ยังมีอิทธิพลทางตรงกับความตั้งใจที่จะใช้งาน

ดังนั้นจึงสรุปได้ว่าซอฟท์แวร์ที่มีการใช้งานที่ง่ายและสภาพสิ่งแวดล้อมการเรียนที่ทำให้เกิดความสนุกสนานหรือความเพลิดเพลินในการใช้งานจะส่งผลที่ดีต่อความสำเร็จในการเรียนรู้ของผู้เรียนระดับต้น ทำให้ผู้เรียนระดับต้นแสดงความพยายามเพื่อที่จะประสบความสำเร็จทีละขั้นในการเรียนรู้ระบบERP

Abstract

Enterprise Resource Planning (ERP) system has become a mainstream protocol to integrate the data across an organization on a single database. Due to its increasing importance in the business world, many higher educational institutions have organized in-house ERP courses to educate their students to get ready for future careers. In this study, the university students are considered as entry-level learners. As the objectives of this study, it is interesting to understand how entry-level learners accept to use ERP software and what influences their learning achievement. Here, Technology Acceptance Model (TAM) was applied to analyze the technology acceptance of entry-level learners. The sample data was purposively collected from eighty-eight entry-level undergraduate students enrolled in ERP class at Thai-Nichi Institute of Technology (TNI). Using a path analysis, the influence of two primary TAM factors, which are perceived usefulness (PU) and perceived ease of use (PEU), usage intention (UI) and external factors was studied.

The result shows that both primary TAM factors have a positive effect on usage intention, indicating the technology acceptance. Regarding the learning achievement by test scores; however, only perceived ease of use has a direct effect whereas perceived usefulness has no direct effect. Perceived usefulness has only the indirect effect on the achievement through the learners' usage intention.

Regarding the effect of external factors, job relevance and output quality is found to have significantly the positive effects on perceived usefulness whereas playfulness (or enjoyment) and objective usability have significantly the positive effects on perceived ease of use. Moreover, playfulness (or enjoyment) also has the direct effect on usage intention.

Therefore, it is implicative that user-friendly software in fun learning environment is required for entry-level learners to initiate the efforts for gradually achieving the learning outcomes of ERP software.

กิตติกรรมประกาศ

งานวิจัยฉบับนี้สำเร็จลุล่วงได้ด้วยความอนุเคราะห์งบประมาณจากสถาบันเทคโนโลยีไทย-ญี่ปุ่น และด้วยความกรุณาจาก ผศ.ดร.จักร ติงศภัทริย์ในการให้คำแนะนำอย่างดียิ่ง

ผู้วิจัยขอขอบคุณผู้มีส่วนเกี่ยวข้องทุกท่านตลอดจนนักศึกษาชั้นปีที่3 หลักสูตรการจัดการอุตสาหกรรมที่ให้ความร่วมมือเป็นอย่างดีในการตอบแบบสอบถามและการสัมภาษณ์

ผู้วิจัย

สารบัญ

หน้า

สารบัญ(ต่อ)

สารบัญตาราง

สารบัญรูป

Chapter 1

Introduction

Background

Accurate, real time and updated information is of great importance to the business success. It contributes to effective planning and decision making carried out by the organization. Nowadays, Enterprise Resource Planning (ERP) has become a mainstream protocol to integrate the data across the entire organization, enterprise and even across the supply chain from upstream to downstream, in different continents throughout the world. The leading companies in various industries have adopted ERP software for running their business.

Among a large number of ERP software vendors, SAP is the most used ERP software vendor in the world. According to Forbes (2013), the worldwide market size of ERP software in 2012 was 24.5 billion US dollars with 2.2% growth over 2011. SAP was ranked number one in terms of its market share of 25%, as shown in Figure 1. Similar to the recent ERP survey by Panorama Consulting Company (2015), SAP is still the most selected ERP software by the ERP customers. In this study, SAP will be used as a representative ERP system.

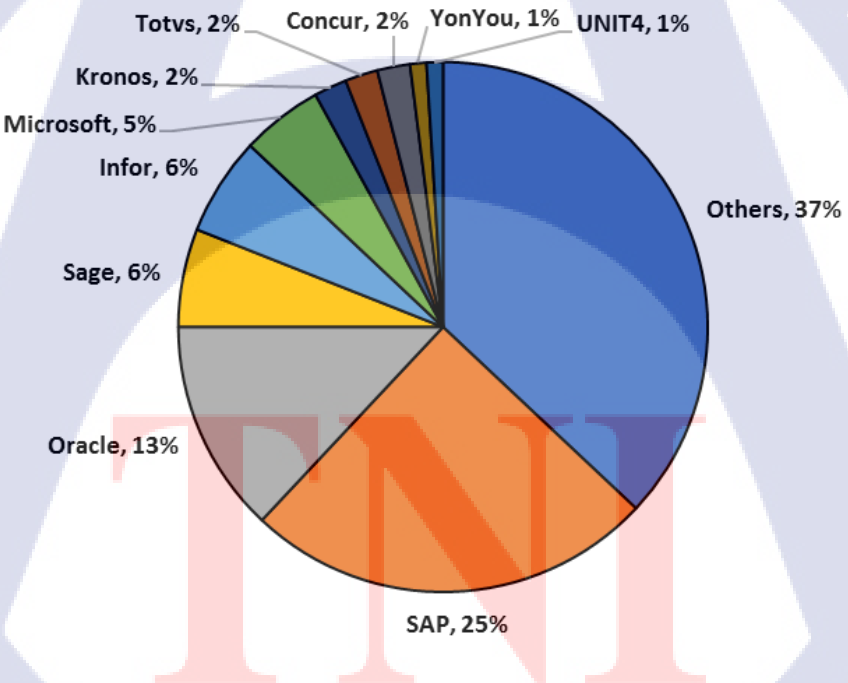


Figure 1 Worldwide ERP market share in 2012 (Forbes 2013)

Since SAP is specifically-purposed software in business world, it is not generally seen in daily life like spreadsheet software such as Excel. As a matter of fact, most of the entry-level users have never seen SAP screen before their first use. Compared to Excel screen, SAP screen at present somehow does not look colorful and user-friendly although it has been far better than what it used to look like in monochrome period. To entry-level users, SAP software may have its image as difficult-to-

use software. In addition, understanding the business data underlying in the business flow is essential to grasp the core concept of ERP. Thus, learning process to achieve the success in ERP learning is not simple.

The success in ERP training or learning was found relevant to the successful implementation of ERP system in the change management program (Calvert, 2006). With the consideration of ERP as software technology, thus the emphasis on the acceptance of technology cannot be avoided in the discussion of ERP learning as a part of ERP system implementation. In other words, the ERP learners should accept the technology in order to learn the technology. Since Technology Acceptance Model (TAM) was originally proposed by Davis F.D. (1986, 1989, 1993), TAM model has been the most-widely cited model to explain the user acceptance for the past two decades; especially in the field of information technology and system (IT/IS). It has been vastly re-examined, extended and applied in many cases related to the information technology and information system adoption (e.g., Chuttur (2009), Lee (2003), Nelson (2007), Park (2009), Tsai (2012), Vankatesh (2000)). According to Lee (2003), more than 100 papers related to TAM were published in leading IS journals and conferences. Along with literature review, TAM model is proposed to adapt here in order to develop the theoretical framework to examine the achievement of ERP entry-level learner from a perspective of Technology Acceptance. In other words, it is interesting to understand how the perception of Technology Acceptance influences the learning achievement of ERP entry-level learners.

Here, the ERP entry-level learner is defined as a person who works as an **end user** in the real work place; e.g. buyer and production planner job, and **new to ERP** system. Most of them don't have the background of Information Technology or Computer Science, but are rather from Business Administration.

Due to increasing importance of ERP software, many higher education institutions have paid more attentions on teaching ERP software to their students. According to the information from SAP University Alliance (UA SAP, 2016), fifteen Thai universities including Thai-Nichi Institute of Technology (TNI) have joined SAP UA program and have organized in-house ERP courses. Thai-Nichi Institute of Technology has SAP software class taught in undergraduate school in Faculty of Business Administration (BA) and Faculty of Information Technology. The focus of the study here is the undergraduate students in Faculty of Business Administration, which are proposed to be treated as the subjects for ERP entry-level learners, because those students in Faculty of Business Administration study ERP software in order to prepare themselves to get ready for future careers as end users in the business, e.g., in sales, production planning, and purchasing functions. Hereinafter, they are also called "BA students", or "the students". SAP software taught for BA students is only in the course of Practical Production Planning and Control (Course code: IMA-314) in Industrial Management Program. The students who attend this course are the third year students.

Although BA students in the university and actual ERP end-users in the company have different objectives in nature of learning ERP software, they are similar in the following two aspects to

be the ERP entry-level learners. Therefore, the results analyzed from the BA students should be able to be used to understanding the behavior of actual ERP end users.

1. New to ERP software.

   Most of entry-level ERP end-users in the company such as buyers and planners are not from IT-related background; therefore, they are supposed to be in equivalent ERP experience level as the undergraduate students.

2. Mandatory environment.

   The company selects the ERP software as the best available tool for the company. ERP end-users in the company are compulsory to use the selected ERP software as it is a working tool for work effectiveness whereas BA students are required to use ERP software as it is a requisite study for grade acquisition.

Objectives

1. To understand the relationship between the achievement in ERP learning and TAM variables including their external variables
2. To identify the external variables having the significant effect on two primary TAM variables
3. To examine the change of TAM variables over time due to learning progress

Research scopes

The scopes of this research can be divided as below.

1. Population and samples:

   The number of samples were equal to the number of population. They were 88 BA students who first enrolled in ERP class taught in Faculty of Business Administration. Since the focus of the study was the entry-level ERP learners. The re-enrolled students were not in the scope of the study.

2. Contents and Variables:

   The variables in the study are based on TAM models with added external factors. Therefore, the variables involved in this study are Perceived Usefulness (PEU), Perceived Ease of Use (PEU), Usage Intention (UI), Learning achievement and external factors. All variables are demonstrated in the conceptual framework as in Figure 2. In addition, demographic data of gender, GPAX, the grade in the previous computer class, the hours spent on computer at home and SAP installation at home was also collected.

   Potential external variables for PU are subjective norm, image, job relevance, and output quality. Potential external variables for PEU are self-efficacy, perception of external control, anxiety, computer playfulness, perceived enjoyment and objective usability.

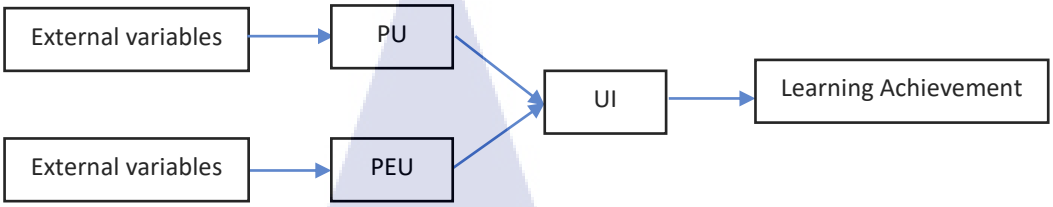


Figure 2 Variables in conceptual framework

3. ERP software:

SAP was used in this study. SAP was under the license from SAP UA program joined by Thai-Nichi Institute of Technology (TNI).

4. Study period:

The data was collected, analyzed and summarized from June 2016 to April 2017.

5. Research method:

The questionnaires were used to collect the data. The data was analyzed statistically with hypothesis. More details will be explained Chapter 3.

Expected benefits

1. The results enable the ERP instructor to find the appropriate teaching approach for the sake of effective learning by considering the external variables
2. The results of this research will be used as basic findings and insights about ERP user acceptance for further research in the actual ERP implementation; i.e., effective ERP training in the change management of ERP implementation in the enterprise

Nomenclature

Technology Acceptance:

The phenomenon that the targeted technology is accepted and used by the users.

Perceived Usefulness (PU):

According to David (1985), it was defined as *"the degree to which an individual believed that using a particular system would enhance his or her performance".* It is considered as one of primary variables in TAM model.

Perceived Ease of Use (PEU):

According to David (1985), it was defined as "*the degree to which an individual believes that using a particular system would be free of physical and mental effort*." It is considered as one of primary variables in TAM model.

Enterprise Resource Planning (ERP):

The software used to manage the data in the business process. It contributes to the integration of business data in a single database that allows the organization activities to move in real-time or automatic manner with accurate information. It helps the management to improve the decision making. The business data is such as sales, marketing, inventory, purchasing and even human resources.

Usage Intention (UI):

The state of mind in determining or aiming such a manner to use something.

Mandatory condition:

The compulsory environment setting that does not allow the persons involved to select other options

Entry-level ERP learner:

The learners who learn the ERP software as the first time. Since the samples in this study are the university students, the word “learner” and “student” will be used interchangeably.

Chapter 2

Theory and literature review

This chapter contains three main topics as follows.

1. Enterprise resource planning (ERP)
2. Technology Acceptance Model (TAM)
3. Literature review

Enterprise resource planning (ERP)

In the business, there are main four functional areas of operations: marketing and sales, supply chain management, accounting and finance, and human resources. Each area has its own activities to execute to support the business flow. The examples of functional areas and its activities are shown in Figure 3. Even though the company has organizational structures that separate the functional area, they require the information from other functional areas as inputs to do their works as outputs. For example, the supply chain area will need the input of customer sales order from the sales area, who receives the order from the customers, to calculate the material requirements to order the raw materials for manufacturing.

Functional area	Marketing and sales	Supply chain	Accounting and finance	Human resources
Business activities in functions	Marketing a product	Purchasing goods and raw materials	Accounting of payment from customers and suppliers	Recruiting and hiring
	Taking sales order	Receiving goods and raw materials	Cost allocation and control	Training
	Customer support	Transportation and logistics	Planning and budgeting	Payroll
	Customer relationship management	Scheduling the production runs	Cash flow management	Benefits
	Sales forecasting	Manufacturing goods		Government compliance
	Advertising	Plant maintenance		

Figure 3 Examples of functional areas and its activities
Source: Concept in enterprise resource planning (Monk 2013)

The business information needs to be shared throughout organizations or even with business partners outside the company such as the suppliers of raw materials. Especially in the current competitive business environment, sharing information must be accurate, up-to-date and timely. Therefore, the integrated information system is very necessary. The integration contributes to the improvement in communication and workflow. As a consequence, the productivity, efficiency and

effectiveness of business management can be obtained. Thus, the company can be successfully survived with competitive advantage.

Enterprise Resource Planning (ERP) system can provide the solution of integrated information system. It is the software program that can integrate and coordinate the information in each business functional area into one single common database. The central and local computers are networked as in a client-server architecture, which provides scalability that the computers can be added in. With the protocol of single database, the business data is saved in one place as one data across organization. It allows the data to be entered into the system only once, and then the data can be used throughout the organization. By this, it improves the accuracy of communication between functional areas due to one data one place. People are able to see the same information. Less mistakes can be expected. One of the advantages of using ERP can be seen from the proper decision making and planning due to accurate information and reporting system to management. It is an inevitable software to be used in the modern companies. For manufacturing companies, the most apparent benefits are cost control and on-time delivery improvement due to accurate information such as inventory data.

With the development of computer hardware and software, and the emerge of internet, ERP system has been developed greatly. It can be scalable and portable. The data access and retrieval is faster in anywhere. The business world will run in the accelerated speed.

ERP system has been developed by many software developers. According to Forbes (2013), top two ERP developers in terms of worldwide market share was SAP ad Oracle. As SAP is the software used in this study, only SAP will be explained here.

Back in 1972, SAP company was founded by five former IBM system analysts. SAP was originally named in German but in English it stands for 'Systems, Applications and Product in data processing'. The most obstacle of software development at that time was the computer memory and CPU speed. It took almost 20 years to achieve SAP's goal, which was to develop the standard software that integrated the whole company data to be available in real time.

SAP was developed in module, which means individual software in each particular functional area. The modular software can be purchased, installed and run separately by using common database. It allows the company to be flexible in extending the program in the future. From the beginning, the company don't need to invest the whole program for all functional areas. They can purchase only the module in their core interest of improvement. For example, the retail company will purchase only the module of sales & distribution, and the manufacturing company will purchase only the module of production planning. The investment cost can be saved. (Goyal, 2011)

The product of SAP is called 'SAP ERP' (previously called 'SAP R/3' and 'mySAP ERP'). It is run on the technical platform called 'SAP NetWeaver'. SAP ERP has basic functions of each module as bellows. See Figure 4 as well.

- Sales and Distribution module (SD): manages from sales order until scheduled delivery. The customer information such as name, address, discount and etc. is maintained in the module
- Material Management module (MM): manages the acquisition of materials purchased outside the company and the subsequent handling of inventory
- Production Planning module (PP): manages the production planning, scheduling and related activities
- Quality Management module (QM): manages quality control activities such as inspection record
- Plant Maintenance module (PM): manages maintenance resources and planning
- Asset Management module (AM): manages fixed assets and depreciation
- Human Resource module (HR): manages the employee recruitment, hiring and training
- Project System module (PS): manages the planning and control of the projects such as new product R&D, plant construction and etc.
- Financial Accounting module (FI): records the transactions in the general ledger accounts, and generates financial statements
- Controlling module (CO): serve internal management purposes to control the cost and enhance the profitability

Note that FI and CO modules are encompassing over the other modules because most of every activity in the company has an impact on the financial position of the company.

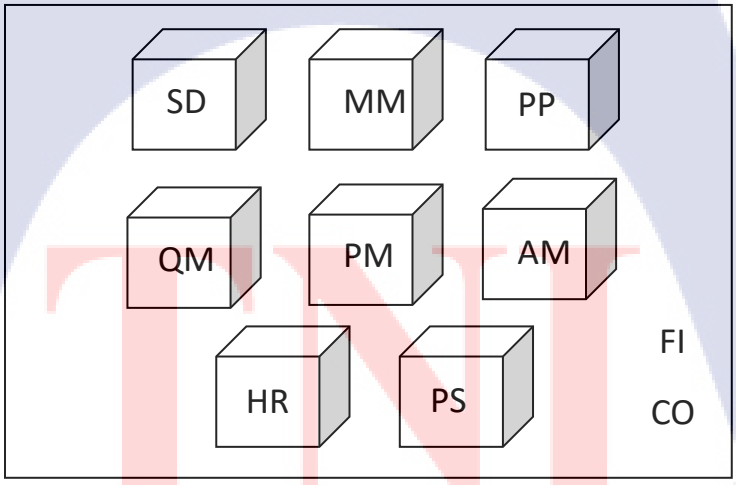
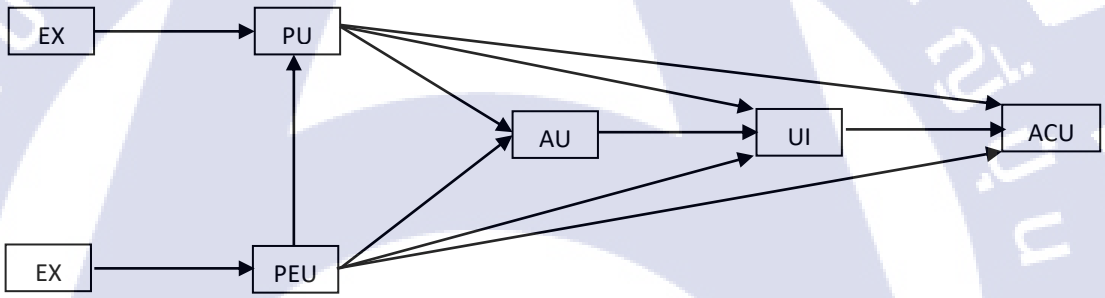


Figure 4 Modules on SAP ERP

Source: Concept in enterprise resource planning (Monk 2013)

Technology Acceptance Model

Due to the adoption failure of information system (IS), many types of research works in the area of IS adoption, for the past few decades, have been carried out with the aim of understanding the factors affecting the successful adoption. One of the significant attempts is to predict the system usage of the users. Among various theories, Technology Acceptance Model (TAM) is the most leading model that has attracted many researchers' attention. TAM was originally proposed by Davis F.D. in his doctoral dissertation in 1986 (Davis 1986). The model was modified from the Theory of Reasoned Action of Ajzen and Fishbein (1975). The main concept of TAM deals with the user motivation in accepting to use the technology. Since the first publication, TAM has been evolved and validated in different research settings such as e-learning (Park, 2009), e-book (Tsai, 2012) and learning management system (Ros & et.al., 2014). In extending TAM, the antecedents of TAM primary factors were studied (Ventakesh & Davis, 1996 and Ventakesh, 2000). Lastly, in 2000, Venkatesh and Davis developed TAM2 as an extended model to original TAM (Venkatesh & Davis, 2000). Holistically, the important variables ever involved in TAM model and their influencing relationships are illustrated as the conceptual framework in Figure 5. The arrows show the causal relationships between all possible pairs of the variables. According to the previous literature review, the relationships don't always appear to be valid in any pairs. The validity depends on the research settings and the population.



PU = Perceived Usefulness PEU = Perceived Ease of Use
EX = External Variable AU = Attitude toward Usage
UI = Usage Intention (Behaviour intention)
ACU = Actual Use

Figure 5 Holistic conceptual view of TAM model

Perceived Usefulness (PU) and Perceived Ease of Use (PEU) are considered as primary factors originally in the model while External factor (EX) is an extended factor and varied depending on the research scopes. As written in Davis's thesis [5], PU is defined as "*the degree to which an individual believed that using a particular system would enhance his or her performance.*" PEU is defined as "*the degree to which an individual believes that using a particular system would be free of physical and mental effort*." Both of these two primary factors are also found to have an association as shown in the figure above. The external factors, such as subjective norm and job relevance for PU, and self-efficacy and anxiety for PEU, are the antecedents of PU and PEU.

Attitude toward Using (AU), influenced by PU and PEU, was originated from the Theory of Reasoned Action and adopted in the original TAM model. The user attitude was a determinant of the actual use (ACU) of the system. But later in the continuing work of Davis, the additional change was

concluded that PU had a directly great influence on the user intention, namely Usage Intention (UI) or Behaviour intention, and on the actual use without forming the attitude (Ventakesh & Davis, 2000). However, the consideration of the attitude into the research framework seems to be optional. Some other TAM-focusing researchers still include the attitude in their research frameworks, but some don't.

Actual Use (ACU) is the actual response from the users after motivated. TAM model was developed to predict whether or not the users would actually use the system. In the meantime, ACU is somewhat the limitation of TAM study since the actual measurement of ACU cannot be directly done. Therefore, self-reporting from the users is normally adopted to collect the data of actual use.

External variables or factors affecting the perceived usefulness are as follows (Chuttur, 2009).

- Voluntariness: The voluntary or free-will degree of using the technology
- Experience: Prior experience of the users in using the technology
- Subjective norm: The expected behaviour from social system
- Image: The perception of social status enhanced when using the technology
- Job relevance: The importance of technology to enhance the users' jobs
- Output quality: The degree that the technology can perform to match the job's goals
- Result demonstrability: The degree that the result of using technology can be observable or communicable to others

External variables or factors affecting the perceived ease of use are as follows (Chuttur, 2009).

- Computer self-efficacy: The self-capability to perform the technology
- Perception of external control: The beliefs controlled by external resources such as time and money
- Computer anxiety: The individual's fear when facing with the technology
- Computer playfulness: The degree of spontaneous pleasure and amusement in interacting with the technology
- Perceived enjoyment: The state of being perceived to be enjoyable, resulting from technology usage experience
- Objective useability: The actual level of the results regarding the efforts to complete the tasks related to the technology

In this study, the voluntariness is not included in the model due to mandatory environment which the users (entry-level learners) have to use the selected technology. Also, the experience is not included either since all the entry-level learners have no prior experience in using the ERP system.

Literature Review

As the objectives of the study in examining the motivation of ERP learning achievement from Technology Acceptance perspective, several research works related to the application of TAM model in different setting were studied. Some of reviewed research papers are summarized in year descending order as follows.

Lederer and et.al. (2000) proposed TAM model to investigate the usage acceptance of the World Wide Web. The study included the antecedents of ease of use and usefulness. Factor analysis and multiple regression was conducted to understand the effects. The results show that (1) ease of understanding and ease of finding predicts ease of use, (2) information quality predicts usefulness for revisited websites. It is suggested that the website developers should provide ease of use and usefulness to encourage people to revisit their sites.

Nelson and Webb (2007) studied the e-book usage acceptance in seven sections of an introductory MIS course in the university. The constructs were the factors of TAM models and the web usability items such as navigational ease and visually pleasing design. Factor analysis and multiple regression was conducted to understand the effects. It was found that both ease of understanding and finding are significant predictors of student perception of e-book ease of use and usefulness. Only usefulness was the significant predictor of the students recommending the same e-book for future classes and hoping to use an e-book in other classes.

Park (2009) analyzed the TAM model in understanding the Korean university students' behavioral intention to use e-learning. Structural equation modeling and path analysis was conducted. The antecedents of self-efficacy, subjective norm and system accessibility were included in the model. The users' attitude toward using e-learning was also included. The results proved TAM model applicability. One of interesting findings in this study is that self-efficacy and subjective norm have significantly effects on the attitude and also the behavior intention in using the e-learning. It was explained in the way that these two factors could help the university students to self-regulate their motivation on e-learning. The significant effect of subjective norm implies the social influence in Korean society as Korean people are encouraged to use IT in every field.

Tsai (2012) studied the consumer behavior intention to use e-books from TAM perspective. The users' attitude toward using e-books was included in the study. Structural equation modeling and path analysis was conducted. Three cognitive factors, which were brand and service trust, perceived usefulness and perceived ease of use, were used to measure the interactions among the factors. The study results are as follows. (1) Brand and service trust, and perceived usefulness has a significantly positive effect on attitude while perceived ease of use does not have an effect. (2) Attitude toward using e-books has a significantly positive effect on behavior intention to use e-books.

Ros and et.al. (2014) applied TAM model to assess the acceptance and intention of the college students to use a third generation of Learning Management System (LMS). Structural equation modeling and path analysis was conducted. The results review that the gadgets and container design have effects on the intention to use LMS through the perceived ease of use as a mediating variable

while the prior experience does not have the effect on the intention. The design of gadgets can improve the simplicity of usage.

From the paper summary mentioned above, TAM model can be applied well in any situation about understanding the acceptance of using technology whereas the technology fields have many varieties from system usage to e-learning. Despite the modification of TAM model and numerous findings from the research works related to TAM validation, TAM model is still a popular model. From the Academic Search Complete of EBSCO database, there are totally 1025 TAM-related academic articles published in 1994-2017 (that is only 45 articles yearly published in average in 23 years) versus 154 articles published in 2016-2017. This high number in the recent years reveals the TAM's ongoing popularity.

Chapter 3

Research Methodology

This study is an interrelationship research to understand the influencing factors and effects based on TAM model. The research was conducted as in the following methodology.

1. Population and samples
2. Data collection
3. Research framework, hypothesis and statistical analysis tools
4. Questionnaire
5. In-depth interview

Population and samples

The population was the BA students who first enrolled in ERP class taught in Faculty of Business Administration since the focus of the study was the entry-level ERP learners. The re-enrolled students were not in the scope of the study.

There was only one ERP-SAP class taught in Faculty of Business Administration in the subject of Practical Production Planning and Control (Course code: IMA-314). There were 88 students in total who first enrolled in this class. They were the 3rd year students in the first semester of Academic year 2016. The number of samples were equal to the number of population.

Data collection

The data was collected via anonymous questionnaires, which were distributed to the students in the class and returned immediately after the questionnaires were filled. The purposive sampling was taken from this class in the 2nd week and 10th week of the semester. The data used in the result and analysis was the data from 10th week because the students had more mature experience in SAP using. The data from the 2nd week was only used to compare the TAM factors with 10th week data.

Research framework, hypothesis and statistical analysis tools

There were three analysis frameworks in this study. The first one was to understand the relationship of primary TAM factors (PU and PEU) including Usage intention (UI) and learning achievement with demographic data. The second and third ones were to understand the influence of TAM factors. The difference between the second and third ones were that the second one was without external factors and the third one was with external factors.

The variables PU, PEU and UI were psychometric variables whereas the learning achievement was measured by the practical test scores achieved from SAP test in the classroom. Hereinafter, ‘TS’ was used as the abbreviation of the learning achievement.

1. Demographic relationship framework

The demographic data of non-IT learners in the ERP class consists of gender, cumulative grade point average (GPAX), the grade obtained in the previous computer class in which the students were enrolled in their second year, the number of hours spent per day on computer usage, SAP software installation for home practices and SAP experience

Theoretical framework is illustrated in Figure 6.

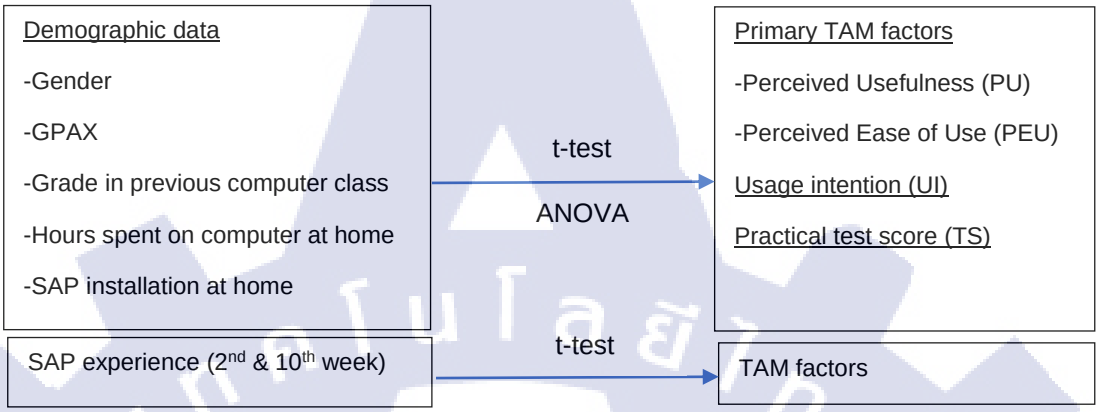


Figure 6 Research framework for demographic relationship

Hypothesis

There were twenty-two null hypothesis in this framework as summarized in Table 1 below.

Table 1 Null hypothesis for demographic relationship framework

Hypothesis	Independent Variables (X)	Dependent Variables (Y)	Statement
H1	Gender	Perceived Usefulness (PU)	X makes no significant difference on Y
H2	GPAX		
H3	Grade in computer class		
H4	Hours spent		
H5	SAP installation		
H6	Gender	Perceived Ease of Use (PEU)	
H7	GPAX		
H8	Grade in computer class		
H9	Hours spent		
H10	SAP installation		
H11	Gender	Usage Intention (UI)	
H12	GPAX		
H13	Grade in computer class		
H14	Hours spent		
H15	SAP installation		
H16	Gender	Ranking of Actual Test Scores (TS)	
H17	GPAX		
H18	Grade in computer class		
H19	Hours spent		
H20	SAP installation		
H20a	SAP experience	PE	
H20b	SAP experience	PEU	

Statistical analysis tools

The statistical analysis, t-test and ANOVA, was conducted to test the hypothesis by using SPSS. A Post-hoc pairwise comparison test was done when necessary.

2. TAM-based influence framework without external factors

For two primary TAM factors, PU was presented as an independent variable whereas PEU was a dependent variable because PEU has an effect on PU. The variables, UI and TS, were also presented as dependent variables.

The framework is illustrated in Figure 7.

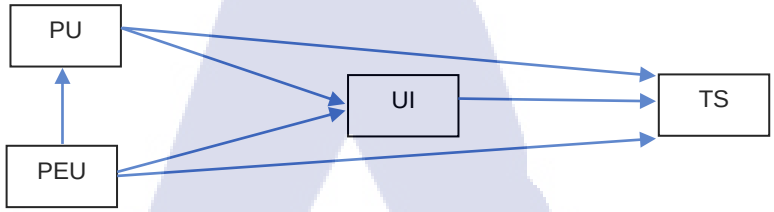


Figure 7 Research framework for TAM-based influence without external factors

Hypothesis

There were six null hypothesis in this framework as summarized in Table 2 below.

Table 2 Null hypothesis for TAM influence without external factors

Hypothesis	Independent Variables (X)	Dependent Variables (Y)	Statement
H21	PU	UI	X has sig. positive effect on Y
H22	PU	TS	
H23	PEU	PU	
H24	PEU	UI	
H25	PEU	TS	
H26	UI	TS	

Statistical analysis tools

Path analysis was conducted by using Lisrel.

3. TAM-based influence framework with external factors

As shown in Figure 8, the research framework was similar to the second framework except there were external factors (EX) that had the effects on two primary TAM variables. Since the external factors for PU and PEU were different, the word 'EXA' was used for PU and 'EXB' was used for PEU. Separately, there were 4 potential external factors for PU; thus, EXA consisted of EXA1, EXA2, EXA3, and EXA4, as shown in Table 3. For PEU, there were 6 potential external factors; thus, EXB consisted of EXB1, EXB2, EXB3, EXB5, EXB5, and EXB6, as shown in Table 3.

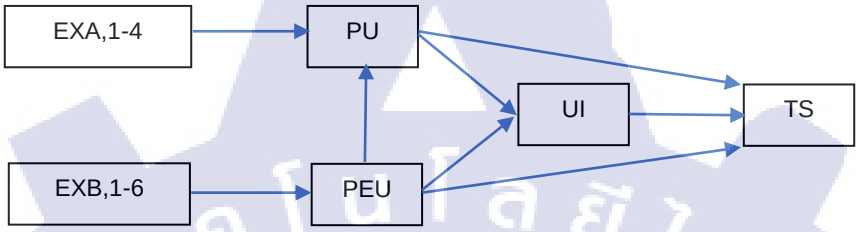


Figure 8 Research framework for TAM influence with external factors

Table 3 Meaning of external variables (EXA and EXB)

Variables	Meaning		Variables	Meaning
EXA1	subjective norm		EXB1	self-efficacy
EXA2	image		EXB2	perception of external control
EXA3	job relevance		EXB3	anxiety
EXA4	output quality		EXB4	computer playfulness
			EXB5	perceived enjoyment
			EXB6	objective usability

Hypothesis

There were sixteen null hypothesis in this framework as summarized in Table 4 below.

Table 4 Null hypothesis for TAM influence with external factors

Hypothesis	Independent Variables (X)	Dependent Variables (Y)	Statement
H27-H30	EXA, 1-4	PU	X has sig. positive effect on Y
H31-H36	EXB, 1-6	PEU	
H37	PU	UI	
H38	PU	TS	
H39	PEU	PU	
H40	PEU	UI	
H41	PEU	TS	
H42	UI	TS	

Statistical analysis tools

Path analysis was conducted by using Lisrel.

Questionnaire

The method used in the study was questionnaire-based in 5-point rating scale from '(1) Very slightly agreed or Very low score rank' to '(5) Very strongly agreed or Very high score rank', respectively. The questions for psychometric variables (PU, PEU, UI, EXA and EXB) were modified from the previous TAM-related research works. Therefore, the content validity of the questions was not carried out in this study.

The number of measurement items for each psychometric variable was summarized in Table 5. See the details of questionnaire in Appendix A (ภาคผนวก ก.)

Note that the learning achievement (TS) was not a psychometric variable. It was the measurement obtained from the actual practical test score in SAP class. In-class SAP tests were conducted twice before the 10th week of the class. Therefore, TS had two measurement items.

Table 5 Number of measurement items for psychometric variables

Variables	Number		Variables	Number
PU	5		EXB1	3
PEU	5		EXB2	4
UI	3		EXB3	3
EXA1	3		EXB4	3
EXA2	2		EXB5	3
EXA3	2		EXB6	2
EXA4	2		TS	1

It is also noted that the average rating of the items in each variable was calculated and used in the statistical data analysis.

In the actual questionnaire, the factor of result demonstrate-ability was included but later it was disregarded in the model due to its ambiguous meaning.

Mean rating score of each psychometric variable and test score ranking is meaningfully expressed as below.

1.00 - 1.80 Very slightly agreed/Very low score rank

1.81 - 2.60 Slightly agreed/Low score rank

2.61 - 3.40 Moderately agreed/Middle score rank

3.41 - 4.20 Strongly agreed/High score rank

4.21 - 5.00 Very strongly agreed/Very high score rank

In-depth interview

After statistical analysis, the semi-structural interview was conducted with four groups of selected students (three persons in each group) in the quadrant shown in Figure 9, in order to reaffirm the findings from the proposed model. The criteria to divide the quadrants were GPAX and the percent of test score obtained in ERP class. The interview was conducted with each individual student.

ERP test score	F1 GPAX < 2.50 Test score > 70%	A1 GPAX > 3.00 Test score > 70%
	F2 GPAX < 2.50 Test score < 50%	A2 GPAX > 3.00 Test score < 50%
	GPAX	

Figure 9 Four quadrants of interview groups

The simple questions below were prepared for the interview; however, the interviewer allowed the students to express their feeling freely in order to get different insights.

- Is ERP/SAP easy or difficult to you? If difficult, what is it?
- Do you feel that SAP/ERP is important? In what way?
- How do you manage to work on ERP/SAP?
- What will you do more to improve the skill?
- What are your obstacles to learn ERP/SAP?
- Do you feel joy or fun during learning?

Chapter 4

Results

The results of this study consist of the following sections.

1. Demographic relationship
2. TAM-based influence without external factors
3. TAM-based influence with external factors
4. Findings from in-depth interview

Demographic relationship

1. Basic information

The frequency results of each demographic data are illustrated in Table 6. There were 88 students in the study. 39.8% of the students were males while 60.2% of the students were females. Most of the students (31.8%) had GPAX in the range of 2.01-2.50. Regarding the grade obtained in the previous computer class (subject code: BUS-210), most of the students (40.9%) received the grade of B or C+. The data shows that most of the students (55.7%) spent less than 4 hours with computer while they most spent time more than 4 hours on mobile phone.

Table 6 Null hypothesis for demographic relationship framework

Description	Frequency	Percent
Gender		
Male	35	39.8
Female	53	60.2
Total	88	100.0
GPAX		
3.51-4.00	9	10.2
3.01-3.50	20	22.7
2.51-3.00	27	30.7
2.01-2.50	28	31.8
1.51-2.00	4	4.6
Below 1.50	0	0.0
Total	88	100.0
Grade in previous computer class		
A, B+	30	34.1
B, C+	36	40.9
C, D+	21	23.9
D, F	1	1.1
Never taken, W, I	0	0.0
Total	88	100.0
Hours spent on computer a day		
More than 6 hours	13	14.8
4-6 hours	26	29.5
Less than 4 hours	49	55.7
Total	88	100.0
Hours spent on mobile phone a day		
More than 4 hours	72	18.2
Less than 4 hours	16	81.8
Total	88	100.0
SAP software installation at home		
Already installed	39	44.3
Not yet installed	49	55.7
Total	88	100.0

The mean and standard deviation of each variable is shown in Table 7. The results show that the students strongly agreed with the usefulness of ERP software rather than thinking that the software was easy to use. In terms of intention to use, they moderately agreed that they would desire to use the software in their future career. Regarding the test score ranking obtained in the class, the students could accomplish the ERP practical test in high ranking. Cronbach's alpha coefficient was also calculated to test the reliability of the items within each psychometric variable. The results are presented in the table below. The coefficients were in the acceptable range (minimum value of 0.60 is recommended). TS does not have Cronbach's alpha coefficient because it is not psychometric variable, but the actual measure of the test score.

In terms of external factors for perceived usefulness, the students strongly agreed that all the factors were important with the highest score due to job relevance.

In terms of external factors for perceived ease of use, the score of each factor ranged differently from moderate to strong agreement, except the factor of anxiety due to opposite scale of measurement. Smaller scores in the anxiety factor show positive opinion due to less anxiety. The students slightly agreed that they had anxiety on using SAP software. Meanwhile, the students gave the highest score on external controls that could help the students improve the process of their ERP learning. The external controls in this study were the facility that could facilitate their learning; i.e., computer and internet, and English proficiency. English language is essential to the learning process of SAP because most of SAP knowledge sources such as Textbook and World Wide Web are in English orientation.

Table 7 Mean, standard deviation and Cronbach's alpha of each variable

Variable	Meaning	Mean	Standard deviation	Cronbach's alpha
PU	Perceived usefulness	3.9045	.65669	0.841
PEU	Perceived ease of use	3.1341	.66624	0.797
EXA1	Subjective norm	3.7634	.67589	0.733
EXA2	Image	3.7443	.83389	0.750
EXA3	Job relevance	3.9489	.78798	0.904
EXA4	Output quality	3.8352	.71808	0.750
EXB1	Self-efficacy	3.1052	.61796	0.637
EXB2	Perception of external control	3.7614	.89852	0.879
EXB3	Anxiety	2.3817	1.05252	0.887
EXB4	Computer playfulness	3.0032	.83183	0.818
EXB4	Perceived enjoyment	3.2031	.90227	0.875
EXB6	Objective usability	3.4148	.83467	0.765
UI	Usage intention	3.2025	.87581	0.900
TS	Learning achievement (Test score)	3.4205	.94652	-

2. Results of hypothesis test for demographic relationship

The hypothesis H1-H20 and H20a were tested and their results are reported as below.

2.1 Effect of gender

The results in the tables below show that male and female students had no significant difference on perceived usefulness, perceived ease of use, usage intention and test score. Therefore, the null hypothesis H1, H6, H11 and H16 was accepted.

Table 8 Hypothesis test results between gender and TAM factors

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
PU	Male	35	3.7829	.68320	.11548
	Female	53	3.9849	.63227	.08685
PEU	Male	35	3.0743	.73578	.12437
	Female	53	3.1736	.62022	.08519
TS	Male	35	3.3857	.94001	.15889
	Female	53	3.4434	.95907	.13174
UI	Male	35	3.1640	.90060	.15223
	Female	53	3.2279	.86679	.11906

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	.539	.465	-1.421	86	.159
Equal variances not assumed			-1.398	68.921	.167
Equal variances assumed	1.078	.302	-.682	86	.497
Equal variances not assumed			-.659	64.157	.512
Equal variances assumed	.501	.481	-.278	86	.781
Equal variances not assumed			-.279	73.960	.781
Equal variances assumed	.140	.709	-.333	86	.740
Equal variances not assumed			-.331	70.959	.742

2.2 Effect of GPAX

The results in the tables below show that the students with different GPAX had significant difference on the test score. By Post-hoc pairwise comparison test (Scheffe test), it was unsurprisingly found that the significant difference on the test score came from the students with much better GPAX and much lower GPAX. Therefore, the null hypothesis H2, H7, and H12 was accepted whereas H17 was rejected.

Table 9 Hypothesis test results between GPAX and TAM factors

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
PU	1.911	4	83	.116
PEU	2.056	4	83	.094
TS	1.371	4	83	.251
UI	.968	4	83	.430

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PU	Between Groups	1.899	4	.475	1.106	.359
	Within Groups	35.619	83	.429		
	Total	37.518	87			
PEU	Between Groups	1.554	4	.388	.870	.486
	Within Groups	37.064	83	.447		
	Total	38.618	87			
TS	Between Groups	26.327	4	6.582	10.584	.000*
	Within Groups	51.616	83	.622		
	Total	77.943	87			
UI	Between Groups	4.904	4	1.226	1.646	.171
	Within Groups	61.828	83	.745		
	Total	66.732	87			

Post hoc test

MEAN DIFFERENCE FOR MULTIPLE COMPARISON IN GPAX

GPAX	3.51-4.00	3.01-3.50	2.51-3.00	2.01-2.50	1.51-2.00
3.51-4.00	-	-	-	-	-
3.00-3.50	0.538	-	-	-	-
2.51-3.00	0.852	0.313	-	-	-
2.01-2.50	1.550*	1.011*	0.698	-	-
1.50-2.00	2.014*	1.475*	1.162	0.434	-

*Significantly different (p<0.05)

2.3 Effect of the grade in the previous computer class

Remark that originally there were four groups of grades, but one group (grade D) had only one case. Test of homogeneity could not be calculated with only one case in a group. So, one case in grade D was re-grouped with grade C, D+. The number of grade groups became three.

When ANOVA was tested in four groups of grades, the results show that the students with different grade had significant difference only on the test score. But in three groups of grades, there was significant difference on both perceived ease of use and the test score. By Post-hoc pairwise comparison test (Scheffe test), it was unsurprisingly found that the significant difference on the ease of use and the test score came from the students with much better grade and much lower grade. Therefore, the null hypothesis H3 and H13 was accepted and H18 was rejected while H8 was conditionally accepted or rejected depending on the re-group condition.

Table 10 Hypothesis test results between grade and TAM factors

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
PU	.072	2	85	.930
PEU	2.666	2	85	.075
TS	1.778	2	85	.175
UI	.516	2	85	.599

ANOVA (in four groups of grades)

		Sum of Squares	df	Mean Square	F	Sig.
PU	Between Groups	2.581	3	.860	2.069	.111
	Within Groups	34.937	84	.416		
	Total	37.518	87			
PEU	Between Groups	2.929	3	.976	2.298	.083
	Within Groups	35.688	84	.425		
	Total	38.618	87			
TS	Between Groups	15.587	3	5.196	6.999	.000*
	Within Groups	62.356	84	.742		
	Total	77.943	87			
UI	Between Groups	3.980	3	1.327	1.776	.158
	Within Groups	62.752	84	.747		
	Total	66.732	87			

Table 10 Hypothesis test results between grade and TAM factors (continued)

ANOVA (in three groups of grades)

		Sum of Squares	df	Mean Square	F	Sig.
PU	Between Groups	2.054	2	1.027	2.462	.091
	Within Groups	35.464	85	.417		
	Total	37.518	87			
PEU	Between Groups	2.695	2	1.348	3.189	.046*
	Within Groups	35.923	85	.423		
	Total	38.618	87			
TS	Between Groups	13.507	2	6.753	8.909	.000*
	Within Groups	64.436	85	.758		
	Total	77.943	87			
UI	Between Groups	3.952	2	1.976	2.675	.075
	Within Groups	62.780	85	.739		
	Total	66.732	87			

Post hoc test (in three groups of grades)

MEAN DIFFERENCE OF EASE OF USE (PEU) FOR MULTIPLE COMPARISON IN GRADE

GRADE	A, B+	B, C+	C, D+, D
A, B+	-	-	-
B, C+	0.205	-	-
C, D+, D	0.461*	0.255	-

MEAN DIFFERENCE OF TEST SCORE FOR MULTIPLE COMPARISON IN GRADE

GRADE	A, B+	B, C+	C, D+, D
A, B+	-	-	-
B, C+	0.597*	-	-
C, D+, D	1.008*	0.410	-

*Significantly different ($p<0.05$)

2.4 Effect of hours spent on computer a day

The results in the tables below show that the hours spent on computer a day had no significant difference on perceived usefulness, perceived ease of use, usage intention and test score. Therefore, the null hypothesis H4, H9, H14 and H19 was accepted.

Table 11 Hypothesis test results between computer hours and TAM factors

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
PU	.193	3	84	.901
PEU	1.133	3	84	.340
TS	1.074	3	84	.364
UI	.348	3	84	.791

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
PU	Between Groups	1.489	3	.496	1.157	.331
	Within Groups	36.029	84	.429		
	Total	37.518	87			
PEU	Between Groups	1.640	3	.547	1.242	.300
	Within Groups	36.977	84	.440		
	Total	38.618	87			
TS	Between Groups	4.673	3	1.558	1.786	.156
	Within Groups	73.270	84	.872		
	Total	77.943	87			
UI	Between Groups	4.363	3	1.454	1.959	.126
	Within Groups	62.369	84	.742		
	Total	66.732	87			

2.5 Effect of SAP software installation at home

The results in Table 13 show that the SAP installation had no significant difference on perceived usefulness, perceived ease of use, usage intention and test score. Therefore, the null hypothesis H5, H10, H15 and H20 was accepted.

This was unexpected finding because by SAP installation at home, the students were expected to have better test scores compared to the students without SAP installation at home. Nevertheless, having ERP software installed at home is recommended as the learners can promptly practice the software at home, especially when they cannot follow the lesson in the ERP class. Table 12 presents the occasions of SAP practice purposes at home. As shown, more non-IT learners tended to practice ERP software when the software was installed at home and used it for catching up the lessons.

Table12 Usage occasion of SAP practice at home

	Never use	For catch up	For test prep
Installed	5	25	20
Not installed	9	14	18

Table 13 Hypothesis test results between SAP installation and TAM factors

Group Statistics

	SAPInst	N	Mean	Std. Deviation	Std. Error Mean
PU	Installed	39	3.9949	.58307	.09337
	Not installed	49	3.8327	.70752	.10107
PEU	Installed	39	3.1846	.53780	.08612
	Not installed	49	3.0939	.75620	.10803
TS	Installed	39	3.4103	.97246	.15572
	Not installed	49	3.4286	.93541	.13363
UI	Installed	39	3.3436	.82849	.13266
	Not installed	49	3.0902	.90433	.12919

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
PU	Equal variances assumed	3.433	.067	1.153	86	.252
	Equal variances not assumed			1.179	85.880	.242
PEU	Equal variances assumed	6.855	.010	.632	86	.529
	Equal variances not assumed			.657	85.021	.513
TS	Equal variances assumed	.015	.903	-.090	86	.929
	Equal variances not assumed			-.089	80.161	.929
UI	Equal variances assumed	.295	.588	1.355	86	.179
	Equal variances not assumed			1.368	84.258	.175

2.6 Effect of SAP experience

The results in Table 14 show that more longer experience in using SAP increased its usefulness significantly while perceived ease of use was not affected significantly. Therefore, the null hypothesis H20a was rejected whereas H20b was accepted. Note that there were seven missing cases in the data collected in the 2nd week. So, the number of cases were 77 for comparison.

Considering the comparison in each question of perceived usefulness, it was found that the questions #3 and #5 has significantly differences between 2nd and 10th week, as shown in Table 15. The question #3 was about the usefulness in the acceleration of learning curve in the company for the future career and the question #5 was about the grade achievement in the class (IMA-314 course). It implies that the students feel more useful in the subjects they are interested in the near future when they experience more during the learning progress.

Table 14 Hypothesis test results between SAP experience and TAM factors

Group Statistics

	Experience	N	Mean	Std. Deviation	Std. Error Mean
PE	2nd week	77	3.8935	.67480	.07690
	10th week	77	4.1221	.59041	.06728
PEU	2nd week	77	3.1610	.69285	.07896
	10th week	77	3.2260	.61589	.07019

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
PE	Equal variances assumed	1.907	.169	-2.237	152	.027*
	Equal variances not assumed			-2.237	149.366	.027
PEU	Equal variances assumed	1.541	.216	-.615	152	.540
	Equal variances not assumed			-.615	149.940	.540

Table 15 Comparison of each question in perceived usefulness

Group Statistics

	Experience	N	Mean	Std. Deviation	Std. Error Mean
Useful1	2nd week	77	4.01	.803	.091
	10th week	77	4.16	.689	.079
Useful2	2nd week	77	3.94	.800	.091
	10th week	77	4.13	.732	.083
Useful3	2nd week	77	3.73	.883	.101
	10th week	77	4.01	.835	.095
Useful4	2nd week	77	4.00	.918	.105
	10th week	77	4.18	.773	.088
Useful5	2nd week	77	3.79	.879	.100
	10th week	77	4.13	.750	.085

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Useful1	Equal variances assumed	1.340	.249	-1.185	152	.238
	Equal variances not assumed			-1.185	148.609	.238
Useful2	Equal variances assumed	1.209	.273	-1.576	152	.117
	Equal variances not assumed			-1.576	150.800	.117
Useful3	Equal variances assumed	3.092	.081	-2.063	152	.041*
	Equal variances not assumed			-2.063	151.525	.041
Useful4	Equal variances assumed	.590	.443	-1.329	152	.186
	Equal variances not assumed			-1.329	147.758	.186
Useful5	Equal variances assumed	5.311	.023	-2.565	152	.011
	Equal variances not assumed			-2.565	148.317	.011*

TAM-based influence without external factors

Using Lisrel to analyze the path effect of the framework in Figure 7 of Chapter 3, it was found that all path relationship had significant effects except that PU had no significant effect on TS. So, the null hypothesis H22 was rejected whereas the null hypothesis H21, H23, and H24-H26 were accepted.

Therefore, the proposed model could be modified as demonstrated in Figure 10 and tested for goodness of fit with the observed data. Table 16 presents the measures for model fits whose values were in the acceptable range.

The details of Lisrel output can be seen in Appendix B (ภาคผนวก ข).

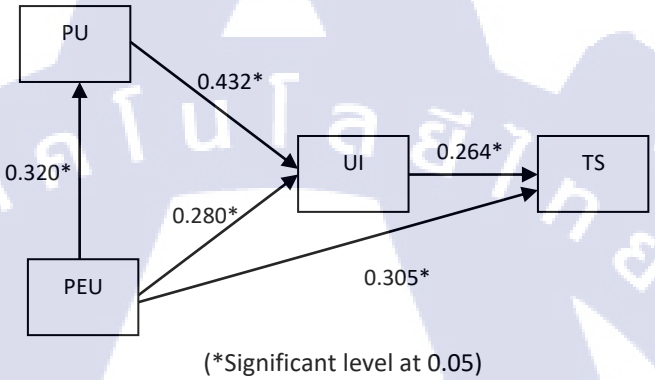


Figure 10 TAM-based model without external factors

Table 16 Measures for goodness of fit

Measures	Recommended value	Obtained value
Chi square (p-value)	p>0.05	0.24 (p=0.62)
RMR	<0.050	0.008
RMSEA	<0.10	0.00
GFI	>0.90	0.99
NFI	>0.90	0.99
CFI	>0.90	1.00

Note:
RMR = Root Mean Square Residual
RMSEA = Root Mean Square Error of Approximation
GFI = Goodness of Fit Index
NFI = Normed Fit Index
CFI = Comparative Fit Index

In Figure10, the parameter estimates for each relationship are indicated. The results show that all the relationships except the pair of PU-TS were valid as in the originally proposed model. The variable PEU had the positive effect on PU. Both PU and PEU had the positive and direct effects on UI while only PEU had the positive and direct effect on TS because PU had only the indirect effect. Also, UI had the positive and direct effect on TS. Thus, it can be said that PU had the positive but indirect effect on TS via UI.

The direct and indirect effects can be summarized as in Table 17 below. The results reveal that UI was directly influenced by PU in higher degree than by PEU (0.432 vs 0.280). But together with its indirect effect, PEU had an equivalent effect, compared with PU (0.418 vs 0.432). In contrast, TS was influenced by PEU directly and indirectly rather than by PU having no direct effect on TS. The factor PU had the only indirect effect on TS through UI (0.114) due to the existing effect of UI on TS (0.264). Since PEU had both direct (0.305) and indirect (0.110) effect on TS through UI; therefore, PEU had the stronger effect on TS than PU did (0.415 vs 0.114).

Table 17 Parameter estimates for effects

	From	Total	Indirect	Direct
PU	PEU	0.320	-	0.320
UI	PU	0.432	-	0.432
	PEU	0.418	0.138 (via PU)	0.280
TS	PU	0.114	0.114 (via UI)	-
	PEU	0.415	0.110 (via PU*UI & UI)	0.305
	UI	0.264	-	0.264

TAM-based influence with external factors

There were 4 external factors for perceived usefulness and 6 external factors for perceived ease of use. First, each external factor was separately tested in the model. The result of individual test is presented in Table 18. For perceived usefulness, each external factor has a significant effect on it. According to R-square, the most predicting factor was job relevance. It implies that the students with strong sense of future job would feel that SAP software was important. For perceived ease of use, all external factors except the anxiety had significant effects on it. It implies that the students with less anxiety did not always perceive the ease of SAP software use.

Table 18 Test of significant effects of external factors on PU and PEU

External factors		Dependent variables	Test result	R-square
EXA1	subjective norm	PU	Significant effect*	0.240
EXA2	image	PU	Significant effect*	0.192
EXA3	job relevance	PU	Significant effect*	0.364
EXA4	output quality	PU	Significant effect*	0.331
EXB1	self-efficacy	PEU	Significant effect*	0.088
EXB2	perception of external control	PEU	Significant effect*	0.059
EXB3	anxiety	PEU	Insignificant effect**	0.041
EXB4	computer playfulness	PEU	Significant effect*	0.217
EXB5	perceived enjoyment	PEU	Significant effect*	0.164
EXB6	objective usability	PEU	Significant effect*	0.143

Remark: *Positive effect **Negative effect

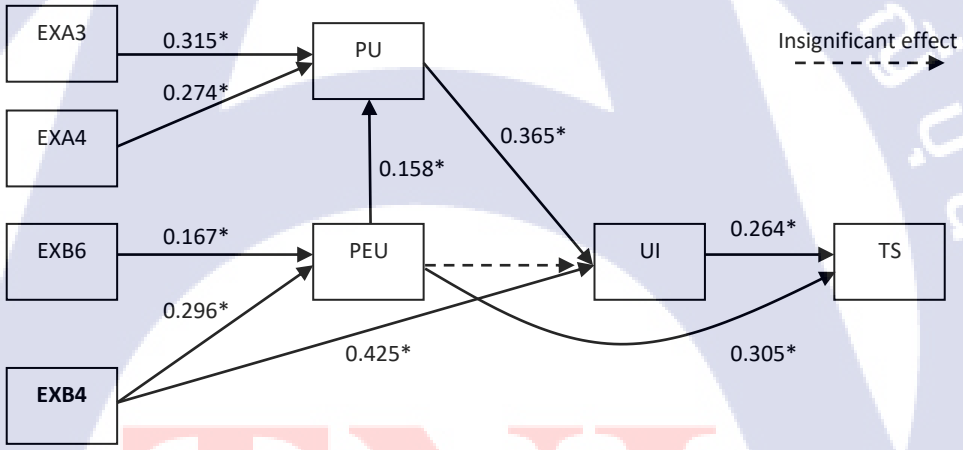
Then, all the external factors were included in the path analysis. The results show that some effect paths became insignificant. Subjective norm and image became less significant when job relevance and output quality was considered simultaneously in the model. Self-efficacy, perception of external control became insignificant when computer playfulness, perceived enjoyment and objective usability was considered simultaneously in the model.

It was also found that playfulness ('ความสนุกสนาน' in Thai) and perceived enjoyment ('ความเพลิดเพลิน' in Thai) had strong correlation. Therefore, in order to prevent the problem of collinearlity, these two variables were not considered in the model in the same time. According to Ventakesh (2000), perceived enjoyment was originally defined as the absorbed playfulness after the users experienced the technology. However, these two terms are very closed in meaning. It was likely that the students who filled in the questionnaires could not differentiate the meaning difference. That's the reason why the answers obtained from these two aspects were similar and correlated coincidentally.

Since the variable EXB4 (Playfulness) and EXB5 (Perceived enjoyment) could not be simultaneous in the model, the model frameworks were modified separately between these two variables. Therefore, two similar models were obtained as illustrated in Figure 11 for EXB4 and in Figure 12 for EXB5. The details of Lisrel output can be seen in Appendix C (ภาคผนวก ค) and Appendix D (ภาคผนวก ง), respectively. The models were also tested for goodness of fit with the observed data. The measures for model fits were in the acceptable range, as shown in the table below.

Since both models had the same results of positive effects on each pair of relationship, the factor of playfulness and the factor of perceived enjoyment are regarded as the same factor in this study.

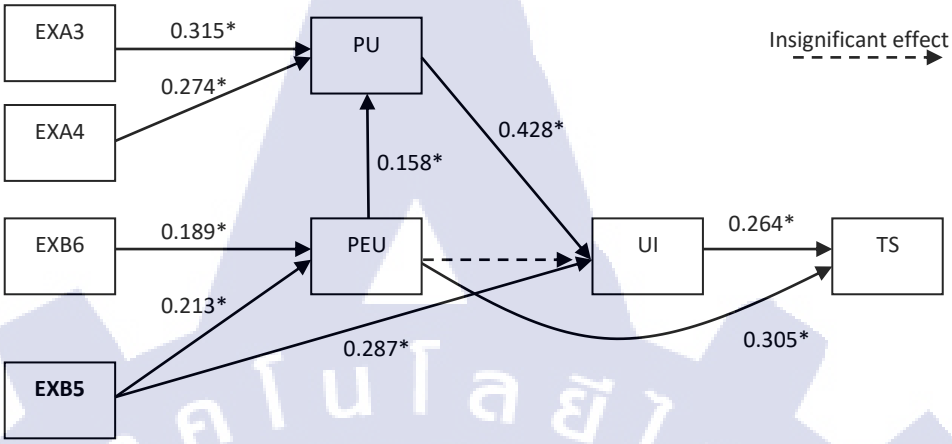
From these two models, it can be seen that either the factor of playfulness or the factor of perceived enjoyment had the direct effect not only on perceived ease of use but also usage intention. Due to this direct effect of playfulness and enjoyment, the degree of direct effect of perceived ease of use on usage intention became insignificant but its indirect effect still existed through perceived usefulness. This implies that the students need fun learning atmosphere in the class room to generate the perception of easiness and the motivation of using the software.



Measures for goodness of fit

Measures	Recommended value	Obtained value
Chi square (p-value)	p>0.05	21.126 (P = 0.07)
RMR	<0.050	0.0393
RMSEA	<0.10	0.0843
GFI	>0.90	0.945
NFI	>0.90	0.904
CFI	>0.90	0.958

Figure 11 TAM-based model with external factors (EXB4 - Playfulness included)



(*Significant level at 0.05)

Measures for goodness of fit

Measures	Recommended value	Obtained value
Chi square (p-value)	p>0.05	17.885 (p=0.162)
RMR	<0.050	0.0386
RMSEA	<0.10	0.0653
GFI	>0.90	0.951
NFI	>0.90	0.914
CFI	>0.90	0.973

Figure 12 TAM-based model with external factors (EXB5 - Enjoyment included)

The direct and indirect effect can be summarized as in Table 19 for EXB4 and Table 20 for EXB6. Despite the number of estimates from two tables was slightly different, it could be seen that both playfulness and perceived enjoyment provided similar results regarding the most influential factors on the learning achievement, which were perceived ease of use, usage intention and playfulness or enjoyment.

Table 19 Parameter estimates for effects (EXB4 - Playfulness included)

	From	Total	Indirect	Direct
PU	PEU	0.158	-	0.158
	EXA3	0.315	-	0.315
	EXA4	0.274	-	0.274
	EXB4	0.047	0.047	-
	EXB6	0.026	0.026	-
PEU	EXB4	0.296	-	0.296
	EXB6	0.167	-	0.167
UI	PU	0.365	-	0.365
	PEU	0.058	0.058	-
	EXA3	0.115	0.115	-
	EXA4	0.100	0.100	-
	EXB4	0.442	0.017	0.425
	EXB6	0.010	0.010	-
TS	PU	0.097	0.097	-
	PEU	0.320	0.015	0.305
	UI	0.264	-	0.264
	EXA3	0.030	0.030	-
	EXA4	0.027	0.027	-
	EXB4	0.207	0.207	-
	EXB6	0.053	0.053	-

Table 20 Parameter estimates for effects (EXB5 - Enjoyment included)

	From	Total	Indirect	Direct
PU	PEU	0.158	-	0.158
	EXA3	0.315	-	0.315
	EXA4	0.274	-	0.274
	EXB5	0.034	0.034	-
	EXB6	0.030	0.030	-
PEU	EXB5	0.213	-	0.213
	EXB6	0.189	-	0.189
UI	PU	0.428	-	0.428
	PEU	0.068	0.068	-
	EXA3	0.135	0.135	-
	EXA4	0.117	0.117	-
	EXB5	0.302	0.014	0.287
	EXB6	0.013	0.013	-
TS	PU	0.113	0.113	-
	PEU	0.323	0.018	0.305
	UI	0.264	-	0.264
	EXA3	0.036	0.036	-
	EXA4	0.031	0.031	-
	EXB5	0.145	0.145	-
	EXB6	0.061	0.061	-

Comparing squared multiple correlation for dependent variables among three model frameworks as in the table below, it shows that the model with external factors could predict the usefulness, ease of use and usage intention better than the model without external factors. However, in terms of learning achievement, it seems that the external factors did not correlate much as R-square did not change a lot. The result was correspondent to the effects explained above since the factors having direct effect on learning achievement was perceived ease of use and usage intention only

Table 21 Comparison of squared multiple correlation for dependent variables

	Model 1	Model 2	Model 3
Perceived usefulness	0.106	0.441	0.438
Perceived ease of use	-	0.251	0.207
Usage intention	0.195	0.300	0.237
Test score	0.139	0.134	0.129

Remark:

Model 1 is TAM-based influence without external factors

Model 2 is TAM-based influence with external factors (Playfulness included)

Model 3 is TAM-based influence with external factors (Enjoyment included)

Findings from in-depth interview

The following findings were discovered from the interview with twelve students. Four groups of the students expressed the similar feeling of difficulty (No. 1), the software importance (No. 2) and obstacles (No. 4). More students in group A1 and F1 could provide the meaningful answers of how to manage their study (No. 3) and what they need for improvement (No. 6). Also, these two groups of the students could clearly answer about the learning fun (No. 5).

1. Is ERP/SAP easy or difficult to you? If difficult, what is it?

   All the interviewed students said SAP is difficult, but more on complexity as described below.

   - A lot of transactions to learn
   - Each transaction has many details of operations and data to understand
   - ERP is performed in continuous flow. So, when the students cannot follow the step, it is difficult for them to continue.

2. Do you feel that SAP/ERP is important? In what way?

   - Most of the students expressed in terms of the efficiency in the actual works and their future jobs. Learning how to use the software now can accelerate the learning curve when they join the companies.
   - However, some said the ERP software was interesting but they did not see much benefits because their career interests were not in manufacturing industry.

3. How do you manage to work on ERP/SAP?
    - Pay more attention / stay on focus / be more concentrated
    - Make understanding of the subjects
    - Self-motivation due to the nature of self-correction
    - Try to get familiar to the software by using it. Then, they will know the trick of software.
    - Realize the importance of software to induce the usage intention
    - Create the confidence in using the software

4. What are your obstacles to learn ERP/SAP?
    - Fear and anxiety to be able to follow the class, or when their computer screens are different from the teaching materials
    - English proficiency
    - No other learning sources in Thai language
    - Friend interruption (chatting, inquiring the questions)
    - Social media interruption
    - Mouse caused the problem during typing
    - Teacher's projection screen is too small to view when the students sit at the back rows
    - No open mind due to initially biased attitude (English is difficult. SAP is difficult.)
5. Do you feel joy or fun during learning?
    - Some don't and some feel.
    - Some students who can help their friends in solving the problems during the class will feel self-esteem.
    - Some feel interested when discovering more function-ability of SAP software
    - Enjoyment can be felt when the students can follow the study without problem
6. What will you do more to improve the skill?
    - More homework may help
    - Clear working flow prior to using the software

Chapter 5

Conclusion and discussion

From the result of model fit verification, Technology Acceptance Model (TAM) can be applied well to understand the technology acceptance of entry-level learners. It is apparent that two primary TAM factors, which are perceived usefulness and perceived ease of use, have positively an influence on the technology acceptance which is measured by the usage intention. Moreover, the perception of software usefulness has the greater impact on the usage intention than the perception of software easiness does. It is the natural sense that people will realize more awareness of the situations involved when they consider the situations are important to them; namely the software is useful. Thus, both primary TAM factors should be considered as fundamental motivation drivers of usage intention.

In terms of test score achievement, the effect of usage intention was found positively and directly. The possible explanation is that the usage intention leads to induce the actual execution of software usage in which the achievement of high test scores is resulted. As a matter of fact, this is what naturally can be expected. Therefore, both primary TAM factors causing the motivation have the indirect influence on the learning achievement by having the usage intention as mediating factor.

In addition, another important finding is that not only the indirect influence exists, but the greater direct influence of perceived ease of use on the test score achievement also exists without mediated. Non-IT learners prefer an ease of software usage to initiate their minimal effort in mastering the software. This result is similar to the findings found by Brown (2002), where the research setting was mandatory, same as in this study. Even though the data of this study was collected from the university students, the finding here is considered to be valid to be applied to the case of general non-IT learners in the real work environment due to the fact that the real work environment is based on mandatory setting as in the university class since the ERP software to be used in the company is the best selected and using only the selected software is compulsory.

In order to reaffirm the findings from the model, the in-depth interview was conducted individually with four groups of selected learners from four quadrants (Group A1, A2, F1 and F2) as shown in Figure 9 of Chapter 3. The criteria to divide the quadrants were GPAX and the percent of test score obtained in ERP class.

In the interview, all groups of the learners mentioned that ERP software was difficult at the initial stage. But Group A1 and F1 realized that the software was not too difficult to master. While they started getting used to it, every single success in pursuing ERP software practices in the ERP class was counted and gained their confidence in pursuing the ERP class. They learned to improve their skills from their previous mistakes well. At the end, they felt less mentally stressed in using the software themselves. In other words, the initial difficulty of software usage is transformed during the ERP learning course as the learners are getting familiar with the software. Oppositely, Group A2 and

F2 kept emphasizing that the ERP software was difficult. Especially, Group F2 showed very little of the indulged effort.

Based on the analysis here, the most influencing factor of TAM model to make an achievement in using ERP software is the perception of ease of use, which can be gained along the learning course. Perceived ease of use can be acquired regardless of the previous academic achievement; namely high GPAX. The presence of Group F1 and A2 is the good evidence of this important finding. If perceived ease of use had had no influences, Group F1 should not have existed since the students with low GPAX should always have had the thought that ERP software was difficult. But the fact, some of non-IT learners with low GPAX could make an achievement if the ease of use was perceived. On the other hands, Group A2 with high GPAX, who have already proved their competitiveness in the prior classes, were expected to prove themselves again in ERP class. But in fact, they could not since they perceived only the difficulty of the software, which influenced their actual abilities.

In addition to perceived ease of use as a significant influence, there must be other influencing factors that play important roles in the learning achievement. As seen in Table 9 of Chapter 4, the groups with excellent GPAX gained significantly high test scores. From the interview, one student from Group A1 expressed that retaining high scores was one of the goals of learning. It is evident that the individual eagerness to obtain the high scores is also added into the motivation of test score achievement.

Moreover, the external factors affecting the primary TAM factors are considered. It is found that the job-related factors, which are job relevance and output quality, have significant effects on the software usefulness and their effects overrun the other factors such as norm. It shows that the students consider the software importance as it is related to their future jobs. In terms of ease of use, the influencing factors are objective usability and either playfulness or perceived enjoyment. Playfulness and perceived enjoyment are regarded as the same factor due to its ambiguous meaning causing the students unable to differentiate the difference in the questionnaires. According to this result, it is recommended that the instructors should create the fun-time software learning environment in the classroom. Regarding the significant effect of objective usability, the contribution of step-by-step learning achievement toward the objective milestones such as in-class assignment completion is important.

As a conclusion, the important factors for successful ERP learning of early-level learners are the perceived ease of software usage with both a direct and indirect effect, and the software usefulness with an indirect effect. The instructors should facilitate the learning atmosphere in order to avoid the learning barriers and to enhance the learning process of entry-level learners so that the ease of proceeding the practices in the class can be obtained. To increase the perception of usefulness, future career-related importance of software usage should be emphasized as the result shows that the perception is increased during the learning progress. To increase the perception of ease of use, gradually realistic achievement and fun-time learning environment can help.