

AN INTEGRATION OF RISK ASSESSMENT AND RANDOM – FUZZY  
NETWORK SCHEDULING FOR COMPLEX CONSTRUCTION OPERATIONS

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A Dissertation Submitted in Partial Fulfillment of the Requirements  
for the Degree of Doctor of Engineering Program in Civil Engineering

Department of Civil Engineering

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การประเมินความเสี่ยงร่วมกับการวางแผนงานก่อสร้างด้วยแรนดอมพีซซีสำหรับการดำเนินการก่อสร้างที่ซับซ้อน



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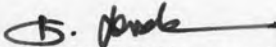
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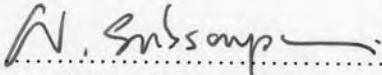
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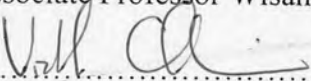
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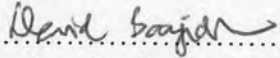
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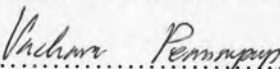
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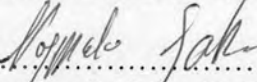
  
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เทอดธิดา ทิพย์รัตน์: การประเมินความเสี่ยงร่วมกับการวางแผนงานก่อสร้างด้วยแรนดอมฟัซซีสำหรับการดำเนินการก่อสร้างที่ซับซ้อน. (AN INTEGRATION OF RISK ASSESSMENT AND RANDOM FUZZY NETWORK SCHEDULING FOR COMPLEX CONSTRUCTION OPERATIONS) อ. ที่ปรึกษาวิทยานิพนธ์หลัก: รศ.ดร.วิสุทธิ ช่อวิเชียร, 311 หน้า.

ความไม่แน่นอนมีสองประเภทคือความไม่แน่นอนจากเหตุการณ์ที่เกิดขึ้นแบบสุ่มและไม่สุ่ม โครงการก่อสร้างขนาดใหญ่หรือโครงการที่มีความซับซ้อนสูงนอกจากจะมีความไม่แน่นอนสูงแล้วยังได้รับผลกระทบจากปัจจัยเสี่ยง เช่น สภาพอากาศที่ไม่ดี วัสดุมีไม่เพียงพอ คนงานไม่มีประสบการณ์ หรือ เครื่องจักรมีประสิทธิภาพต่ำ ปัจจัยเสี่ยงเหล่านี้เกิดขึ้นแบบสุ่มและทำให้เกิดความไม่แน่นอนในการก่อสร้าง นอกจากนี้ความไม่แน่นอนยังมีสาเหตุมาจากการใช้ข้อมูลจากประสบการณ์ ข้อมูลที่ไม่ชัดเจนและแน่นอน อันเนื่องมาจากการไม่มีข้อมูลหรือมีข้อมูลที่ไม่เพียงพอเกี่ยวข้องกับการวางแผนการก่อสร้างและการประเมินความเสี่ยง แม้ว่าซิมูเลชันสามารถจัดการกับความไม่แน่นอนที่เกิดขึ้นแบบสุ่มของกระบวนการดำเนินงานก่อสร้างได้แต่ความถูกต้องของผลลัพธ์ยังขึ้นกับฟังก์ชันการกระจายตัวของตัวแปรแบบสุ่มโดยทั่วไปฟังก์ชันดังกล่าวไม่ได้พิจารณาถึงความไม่แน่นอนที่เกิดจากข้อมูลที่ไม่เพียงพอ การใช้ฟังก์ชันการกระจายตัวที่ไม่ถูกต้องในซิมูเลชันเป็นสาเหตุสำคัญที่ทำให้ได้ผลลัพธ์ที่ไม่ถูกต้อง

งานวิจัยนี้พยายามประมาณระยะเวลาในการก่อสร้างอย่างถูกต้อง โดยการพิจารณาถึงความไม่แน่นอนทั้งสองประเภท งานวิจัยนี้สร้างวิธีการประเมินความเสี่ยงร่วมกับการวางแผนงานก่อสร้างด้วยแรนดอมฟัซซีเพื่อจัดการกับความไม่แน่นอนในการประเมินความเสี่ยง การวางแผนการก่อสร้าง และการประมาณระยะเวลาก่อสร้างสำหรับการดำเนินการก่อสร้างที่ซับซ้อน ข้อมูลที่ใช้ในการประเมินความเสี่ยงประกอบด้วยข้อมูลจากโครงการก่อสร้างในอดีต ข้อมูลจากประสบการณ์และการวิเคราะห์จากผู้เชี่ยวชาญ และข้อมูลจากซิมูเลชัน วิธีการที่พัฒนาขึ้นพิจารณาตัวแปรความเสี่ยงและตัวแปรเวลาเป็นตัวแปรสุ่มแบบฟัซซีที่แสดงด้วยฟังก์ชันความเป็นสมาชิก ฟังก์ชันความเป็นสมาชิกเป็นการรวมกันระหว่างฟังก์ชันความเป็นสมาชิกที่แสดงค่าความไม่แน่นอนแบบไม่สุ่มกับฟังก์ชันความเป็นสมาชิกที่แสดงค่าความไม่แน่นอนแบบสุ่มซึ่งแปลงมาจากฟังก์ชันความน่าจะเป็นของเวลาในการก่อสร้างของแต่ละกิจกรรม งานวิจัยนี้ใช้วิธีซาลิคอนกับระบบนูนฟัซซีเมตะโมเดลเพื่อสร้างฟังก์ชันความเป็นสมาชิกจากฟังก์ชันความน่าจะเป็น ฟังก์ชันความเป็นสมาชิกมีหลายรูปแบบขึ้นกับค่าของความไม่แน่นอน วิธีการคำนวณสำหรับตัวแปรสุ่มแบบฟัซซีถูกนำมาใช้จัดการกับความไม่แน่นอนแต่ละประเภทในการคำนวณเวลาในการก่อสร้างของโครงการจากเวลาในการก่อสร้างของแต่ละกิจกรรม วิธีการที่นำเสนอให้ผลลัพธ์ที่ครอบคลุมเวลาจริงที่ใช้ในการก่อสร้างของโครงการ ระดับความถูกต้องของผลลัพธ์ขึ้นกับการกำหนดค่าความไม่แน่นอนแบบไม่สุ่มและความสัมพันธ์ของปัจจัยเสี่ยงที่ทำการพิจารณา งานวิจัยนี้ได้ประยุกต์ใช้วิธีการดังกล่าวโดยไม่พิจารณาความไม่แน่นอนแบบไม่สุ่ม พบว่าผลลัพธ์ที่ได้มีค่าใกล้เคียงกับผลลัพธ์จากซิมูเลชัน เพราะวิธีการทั้งสองพิจารณาเฉพาะความไม่แน่นอนแบบสุ่มเท่านั้น ทำให้ผลลัพธ์ที่ได้ไม่สามารถสะท้อนความเป็นจริงที่เกิดขึ้นในการดำเนินการก่อสร้างและไม่ครอบคลุมเวลาจริงที่ใช้ในการดำเนินการก่อสร้าง

ภาควิชา วิศวกรรมโยธา

ลายมือชื่อนิสิต..... กอชิตา อังพงษ์ไต้

สาขาวิชา วิศวกรรมโยธา

ลายมือชื่ออาจารย์ที่ปรึกษาวิทยานิพนธ์หลัก.....

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THOEDTIDA THIPPARAT: AN INTEGRATION OF RISK ASSESSMENT AND RANDOM-FUZZY NETWORK SCHEDULING FOR COMPLEX CONSTRUCTION OPERATIONS.  
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The uncertainty may be broadly classified into aleatory and epistemic uncertainty. A large or complex construction project is not only fraught with the aleatory uncertainties, but also influenced by risk factors, such as adverse weather condition, unavailable quantities of materials, operator experience, and poor performance of machines. These risk factors contribute to stochastic phenomenon. Insufficient data or lack of site productivity data compound aleatory uncertainty in the risk assessment and project scheduling by leading to imprecise, vague, and subjective data causing epistemic uncertainty. Although distributions of risk variables and temporal variable are propagated through a simulation model by introducing randomness into the analysis of construction processes, the establishment of probabilistic distributions of random variables is generally provided without a consideration about the epistemic uncertainty. Inaccurate probability distribution can bring about misleading outputs.

This study attempts to provide an accurate duration estimate by examining these two types of uncertainty. A risk assessment integrated within random – fuzzy network scheduling method (RAIRFNET) is developed for modeling uncertainties associated with risk assessment and construction scheduling and estimating activity duration and project completion time. The proposed method uses historical data, subjective data from professional experience and judgment, and simulation data to produce information associated with risk affecting activity duration. Risk variables and temporal variable are considered as a random – fuzzy variable and represented by different shapes of membership functions (i.e., nil, rectangular, trapezoidal). The membership function is developed by inserting the internal membership function representing the fuzzy effect into the external membership function representing the random effect which is transformed from the corresponding probability distribution by using the Salicone's method and neurofuzzy metamodel. Mathematics for random-fuzzy variables are used in the network calculation to propagate each type of uncertainty. The proposed method provides results that cover actual duration. The results can reflect reality of a construction project by addressing every uncertainty. The estimated duration varies based on the assigned value of epistemic uncertainty and dependencies between the considered risk factors. An application of nil internal membership functions provides results close to the simulation results as both of them determine only uncertainty due to the random contribution, but these two methods cannot provide results covering the actual duration.

Department Civil Engineering Student's signature Thoedtida Thipparat  
 Field of study Civil Engineering Principal Advisor's signature Visuth Chovichien  
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