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Information Categorization for Canopy Mapping using Quality Control (QC) Tool – Affinity Diagram (KJ Method)

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Abstract: ***Canopy mapping involves the process of accurately delineating and assessing the distribution and extent of green spaces, trees, and vegetation within a designated area. Understanding the canopy's characteristics is paramount, as it plays a critical role in supporting biodiversity, regulating microclimates, and mitigating the adverse impacts of urbanisation on the environment. This research paper focuses on exploring the practical application of the KJ method and collaborative brainstorming to gather and organize relevant information for canopy mapping. The study engaged six undergraduate students, under the guidance of a faculty member specialized in geoinformatics, in a productive brainstorming session, generating twenty-one diverse ideas related to canopy mapping. Through a methodical process of iterative refinement and consensus-building, the students effectively grouped these ideas into four distinct categories: "Data Sources," "Canopy Estimation Process," "Canopy Map Development," and "Accuracy Assessment." The resulting Affinity Diagram provided a clear and well-structured representation of the research paper's key aspects, harnessing the collective intelligence of the team to organise complex information and facilitate the precise mapping of tree canopies. This collaborative approach proved instrumental in enhancing the project's efficiency and effectiveness, promoting a cooperative environment that fosters innovation and informed decision-making.***

Keywords: ***Canopy Mapping, KJ Method, QC Tools, Brainstorming, Affinity Diagram***

I. INTRODUCTION

A canopy is the uppermost layer of a forest or vegetation, consisting of dense foliage and interconnected branches that form a protective cover over the lower layers. Canopy mapping employs remote sensing methods such as satellite imagery to gather intricate information about distant vegetation [3]. This data undergoes processing to differentiate plants from other objects and categorize various plant species. The resultant maps provide valuable insights into ecological trends, land utilisation, and environmental transformations. These insights support well-informed choices in urban planning and the sustainable management of natural resources.

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The Affinity diagram, also known as the KJ Method, is a collaborative tool for organizing and analysing a plethora of ideas or data points [2]. Participants generate ideas, which are written on sticky notes and then grouped into related categories. These categories are labelled to capture their essence. By physically arranging these notes on a surface, the diagram visually represents the relationships between ideas, enabling insights into patterns and themes. This technique fosters collaboration, aids decision-making, and enhances understanding of complex information through its intuitive visual representation.

The literature review unveils the following findings. The utilization of quality tools like the Pareto Chart, Affinity Diagram, and Spider Plot Diagram has resulted in the improvement of product quality [1]. Through the integration of the CKP algorithm and the KJ method, a comprehensive understanding of reoccurring construction issues is achieved, allowing for their classification into distinct categories and contributing to the improvement of bridge construction quality [4]. The Affinity Diagram systematically categorizes the causes of underemployment among Engineering Graduates into six groups, serving as an enlightening resource for current undergraduates to make informed decisions for improving their career prospects and employability. The Kansei-Based KJ Method offers a fresh approach to comprehend employees' affective experiences, mitigating self-reporting drawbacks, and providing a replicable process for understanding emotional states and Counterproductive Work Behaviour (CWB) in organizational contexts [5]. Reflecting on a decade's experience, the affinity diagram process has been adapted for HCI and interaction design evaluations into four stages: note creation, clustering, wall interaction, and documentation, highlighting the value of traditional paper affinity diagrams in collaborative analysis despite the convenience of digital formats [6]. This paper aims to apply the KJ method to a canopy mapping project. The project team comprises a project faculty member specialising in geoinformatics and six third-year students from the Civil Engineering Department. A brainstorming session was conducted with the students to gather information about canopy mapping, and the received inputs were categorized under relevant topics to establish the project's activity sequence. This research paper is divided into three sections. The first part comprises the introduction and literature review, followed by the second part, which presents the discussions and results. The third part concludes the paper with final remarks.

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II. DISCUSSIONS AND RESULTS

This study aims to gather and categorise information on canopy mapping from project students to establish the sequence of activities for the project.

Phase – 1: Gathering Credible Information for Creating an Affinity Diagram

The initial stage involves providing an introduction to canopy mapping for the project students, followed by formulating a problem statement: "How can we achieve precise tree canopy mapping?" to proceed with the Affinity Diagram. The commonly employed technique for generating ideas is brainstorming, and it serves as the primary method used in this study. To facilitate idea generation, a brainstorming session was conducted with six project students under the guidance of the project faculty. During the session, students were encouraged to participate actively, resulting in the generation of a total of twenty-one diverse ideas. The project faculty meticulously recorded all the ideas on a board. The information gathered during this session is presented in "Table 1: Scramble Information."

Table 1: Scramble Information on Canopy Mapping (by Project Students)

Point No.	Information on Canopy Mapping by students
1	Satellite images
2	Manual digitization
3	Photograph from an elevated surface
4	Ground measurement
5	Confusion matrix
6	Map to ground scale.
7	Total Station
8	Drones
9	Canopy Density
10	Measuring tapes
11	Canopy polygons
12	Normalized Difference Vegetation Index (NDVI)
13	Reference to old maps
14	Supervised classification
15	Cadastral maps
16	Global Positioning System (GPS)
17	North Arrow
18	GIS Analysis
19	Aerial photographs
20	Unsupervised classification
21	Google Earth Pro

Phase – 2: Forming an Affinity Diagram by categorizing the collected credible information.

The information collected on canopy mapping appears disorganized and challenging to comprehend due to its scattered nature. Consequently, categorising this information into distinct groups will facilitate a more transparent and more coherent understanding of the subject matter. By grouping related ideas, patterns and connections can be identified, allowing for a more structured and organized representation of the data. This categorisation will help discern common themes and key insights, providing a clearer understanding of the overall picture and enhancing the effectiveness of the analysis. The ideas generated during the brainstorming session are individually categorised by each of the six project students based on their utility and relevance. The groups formed by the students are then subjected to a refining process, where they provide feedback and make adjustments to each other's groupings until a consensus is reached among all participants. After this collaborative refinement, each category of information is assigned a title using an adapted brainstorming process. This involves brainstorming potential titles for each group, considering their standard themes and main characteristics, to create meaningful and descriptive labels that accurately represent the contents of each category. The iterative nature of this process ensures that the final categorisation and titles accurately capture the essence of the information, thereby enhancing the clarity and understanding of the data for the entire project team. The process of categorisation has led to the emergence of four distinct categories: "Data Sources," "Canopy Estimation Process," "Canopy Map Development," and "Accuracy Assessment." These categories were derived from a grouping exercise, where project students collaboratively organised the gathered information based on its similarities and relevance to each other. The outcomes of this categorisation process are visually represented in "Figure 1: Affinity Diagram," which showcases the relationships between ideas within each category and provides a clear and organised overview of the key aspects of the canopy mapping project. The Affinity Diagram serves as a valuable tool to comprehend the interconnectedness of the information better, aiding in guiding the subsequent phases of the project based on the insights obtained from this comprehensive analysis.

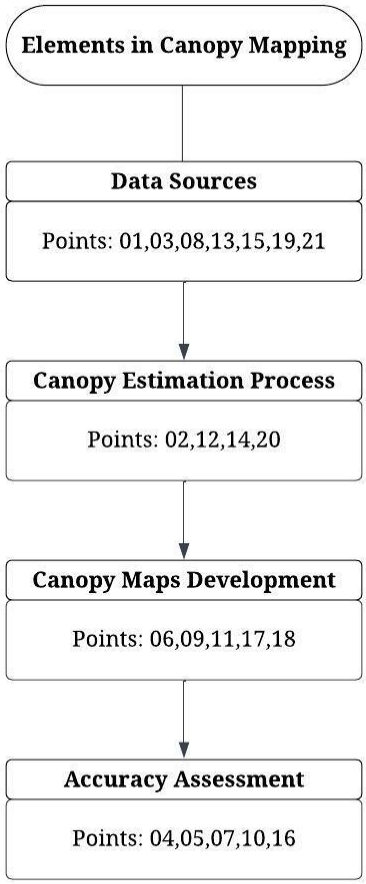

Fig. 1: Affinity Diagram (Ordered information on Canopy Mapping)

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III. CONCLUSIONS

The canopy mapping project employed the KJ method and the power of collaborative brainstorming to gather and organise valuable information on canopy mapping techniques.

The process involved facilitating a brainstorming session with six project students, resulting in the generation of twenty-one diverse ideas. Through iterative refinement and consensus-building, four meaningful categories were established: "Data Sources," "Canopy Estimation Process," "Canopy Map Development," and "Accuracy Assessment."

The Affinity Diagram created from this categorization provided a clear and coherent representation of the project's critical aspects, fostering a deeper understanding of the complex relationships between the ideas. This visualization served as a guide for further project development and decision-making. By utilizing the collective intelligence of the project team, the study successfully transformed scattered and unclear information into a structured and actionable plan.

The comprehensive insights gained from the Affinity Diagram will enable the project team to navigate the canopy mapping project with clarity and efficiency. The categorized information and well-defined categories will serve as a foundation for informed decision-making, ensuring the project's success in accurately mapping tree canopies and contributing to the broader field of geoinformatics and environmental studies.

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