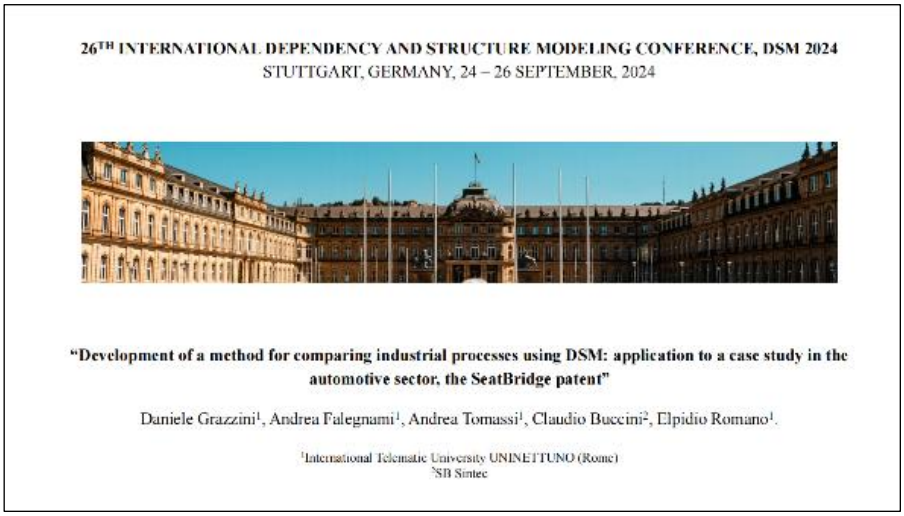
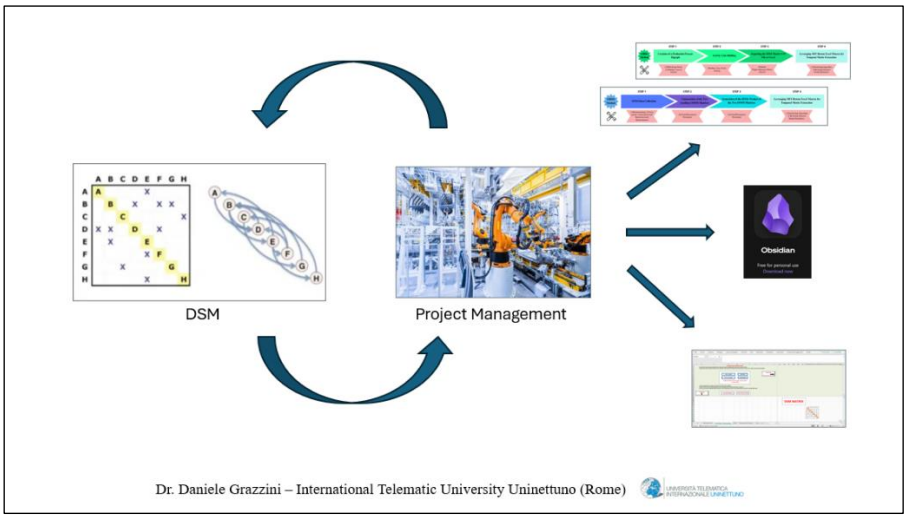
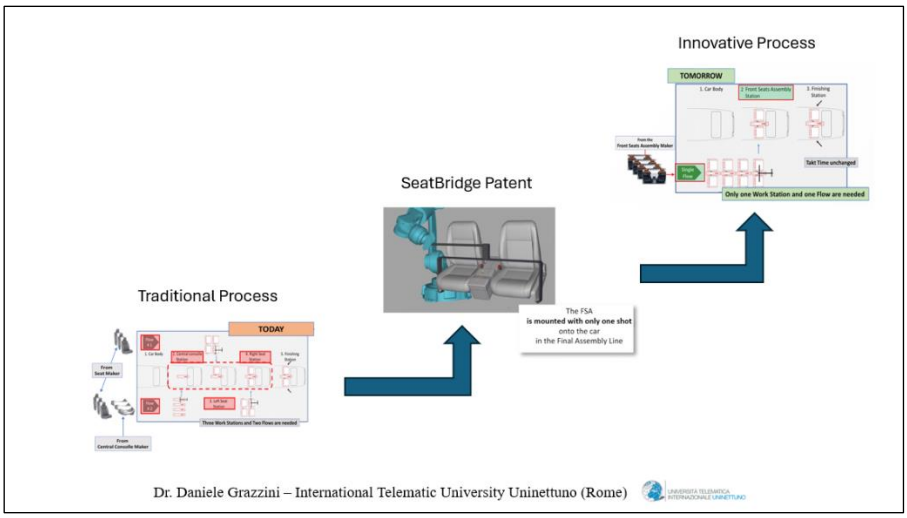
Speech at the international DSM congress in Stuttgart 24-25-26 September 2024



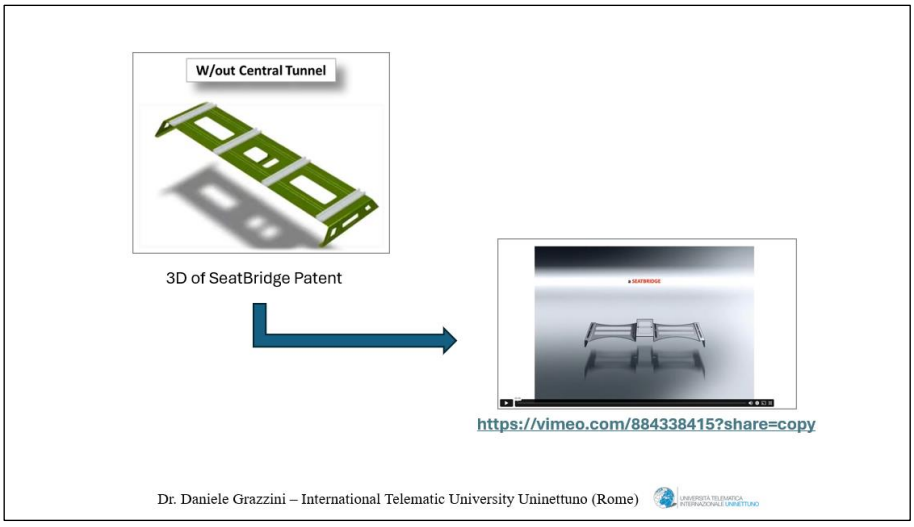
Good morning everyone, my name is Daniele Grazzini and I'm going to bring to your attention the problem of comparing two industrial processes in order to determine, through the analysis of a time and cost metric, which one is the most cost-effective. I hope that it will be of interest to researchers in the field and that my contribution will be useful to increase theoretical knowledge, but also to provide a reference for application in business practice.



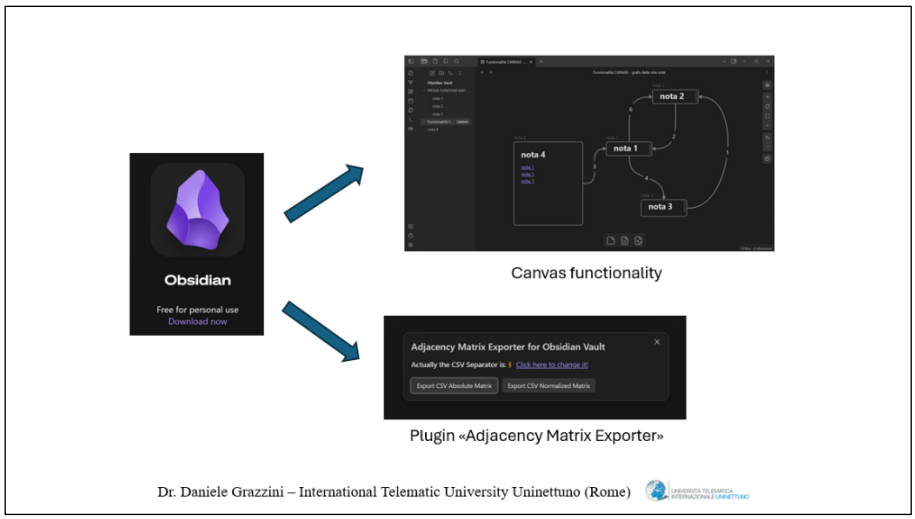
In today's project management profession, we believe it is of great interest to have a "reliable" tool for scenario selection. In addition, the methodologies we propose not only follow a step-by-step path, but also make use of innovative IT tools such as the "Adjacency Matrix Exporter" plugin developed within the Obsidian.md platform, an open-source platform, and the "Activities/Parameters" macro Excel spreadsheet implemented within the MIT spreadsheets in Boston.



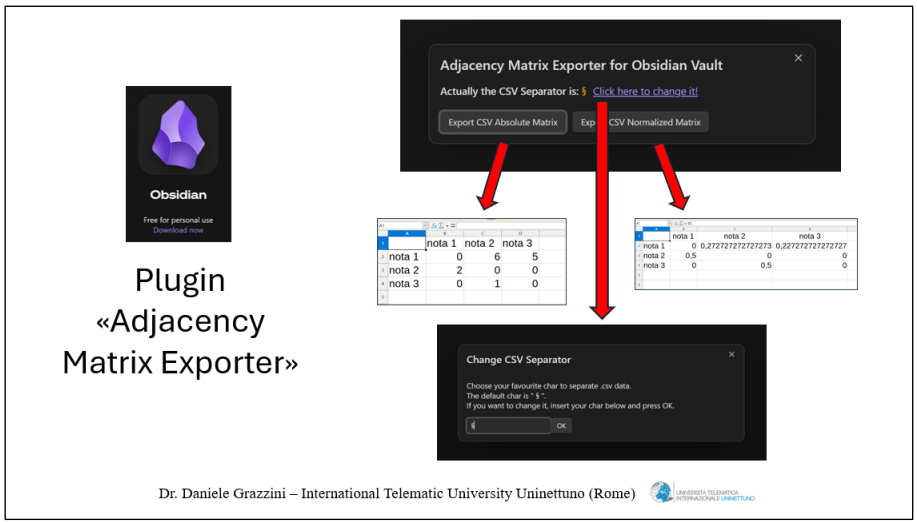
The experimental study to test the reliability of the methods, which will be illustrated shortly, was carried out on the process currently used by the automotive industry to assemble car front seats, referred to in this article as the traditional process, and on the process in which the SeatBridge patent was incorporated, referred to as the innovative process (a patent that I am proud to say was conceived by Professor Claudio Buccini, an Italian naval and mechanical engineer with a long and prestigious career in both the working and academic fields). At the end of the study, it was possible to answer the question of whether the patent had improved the current production process in terms of time, and the answer was affirmative, with a reduction in assembly time of the order of 30%. (The mathematical simulation model also allows a cost metric to be derived, but this was not calculated in the proposed experimental work).



The slide image shows the patent. The solution is basically a bridge structure into which the two seats and center console are directly mounted and which form, when assembled on the assembly line, a single block called the FSA - Front Seats Assembly. I will now show you a short film of about two minutes so that everyone can better understand the functionality and structure of the SeatBridge: https://vimeo.com/884338415?share=copy



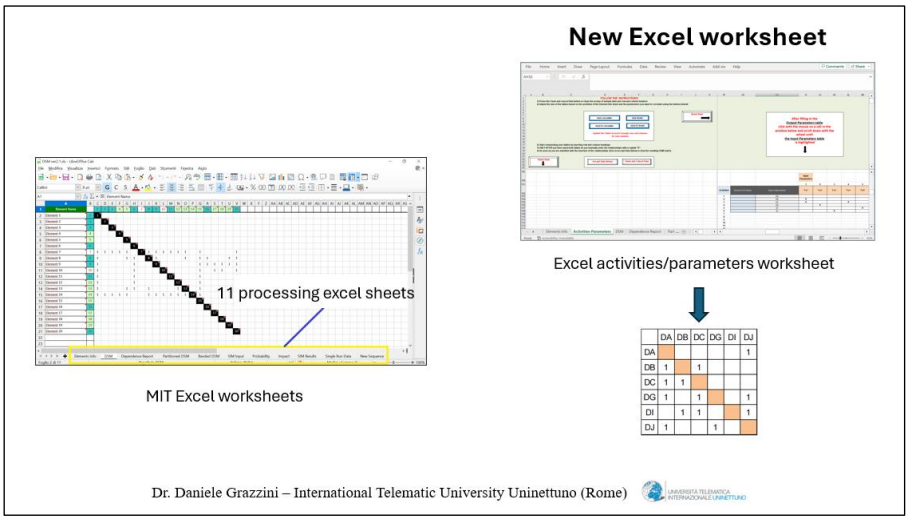
I want to bring to your attention to the two main tools developed specifically for the workflow used within the present research: the first relies on the Obsidian software, a Personal Knowledge Management Tool which quickly became popular since its first release in 2020. Obsidian possesses some interesting features like that one of being entirely Markdown-based and fully customizable. Obsidian's expansion capabilities relies upon a wide community of developers/users. Moreover, Obsidian allows for managing notes (simple chunks of markdown text) and creating links between them. The linked content can be effectively visualized as a network. My research group sensed the potential of this software to implement graph theory by deriving the concept of Adjacency Matrix with weights. We derived this naturally by identifying the nodes of the digraph of our interest with the notes, the edges or arcs with the links between the notes and defining the total number of links from note i to note j as the weight. Through the canvas, a feature originally developed by the community for visual purposes, it was also possible to directly study the digraph of a production process, graphically drawing the links and their weights between the activities of the process, to arrive at an extraction of the connected adjacency matrix through the aforementioned plugin.



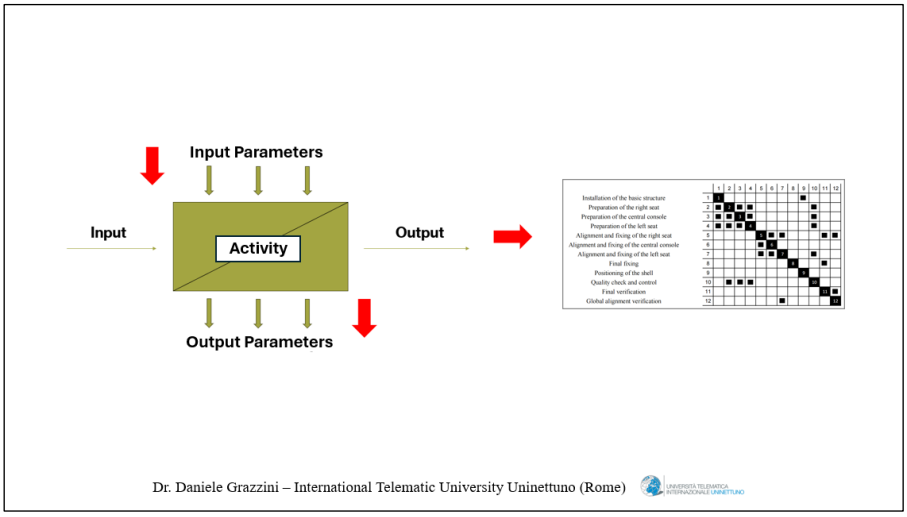
I personally developed another plugin: The "Adjacency Matrix Exporter", which generates an adjacency matrix exportable in CSV format. Once exported, the adjacency matrix can be analyzed elsewhere, by means of further tools, likewise Microsoft Excel or iGraph[1]. The plugin was coded in Typescript language (which is basically a typed JavaScript). The "Adjacency Matrix Exporter" plugin

[1] It is a graph analysis package in R, or Python.

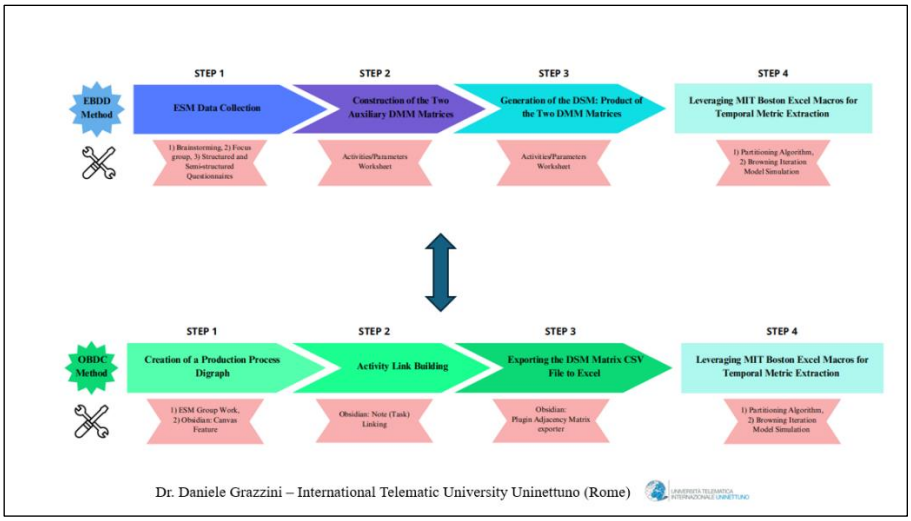
became part of the official Obsidian's Community plugins on December the 6th, 2023 after undergoing a thorough review process. Briefly speaking, it allows for the creation of the Vault note adjacency matrix csv file in two modes: the Absolute mode and the Normalized one. In the former, the links between notes are simply counted with their multiplicity; in the Normalized mode such multiplicity is divided by the length of the note in number of words. This latter feature is useful in many other contexts such, for example, computational linguistics.



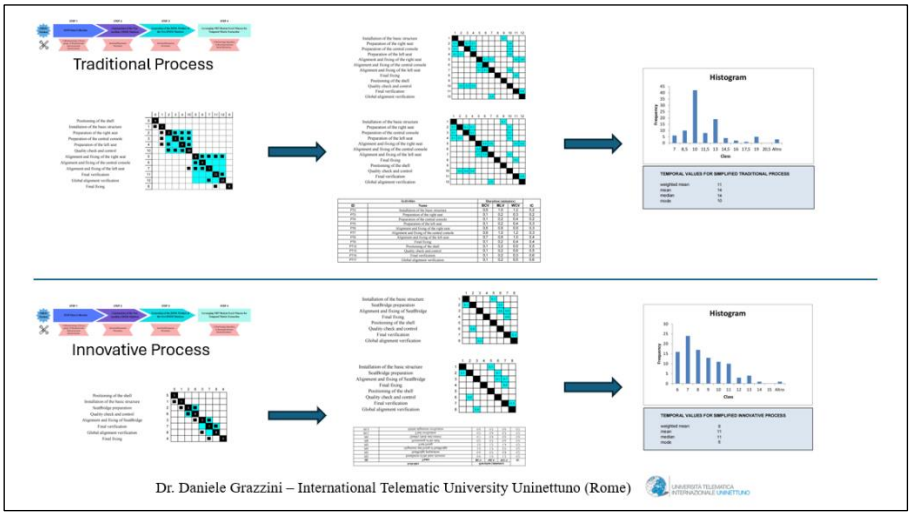
The other tool specifically created for our workflow is the "Activities - Parameters" worksheet. Think of it as a Microsoft Excel on steroids which was intended to complement the VBA Boston MIT sheets. As probably you already know, they start with the ready-made DSM matrix and then apply the mathematical model of data processing to the parameters involved. The addition of this sheet allows the DSM matrix to be derived from the two DMM matrices, one input and the other output of the production process under study. In this work, the DMM matrices were obtained by collecting data from industry experts through focus groups, brainstorming and the administration of structured and semi-structured questionnaires.



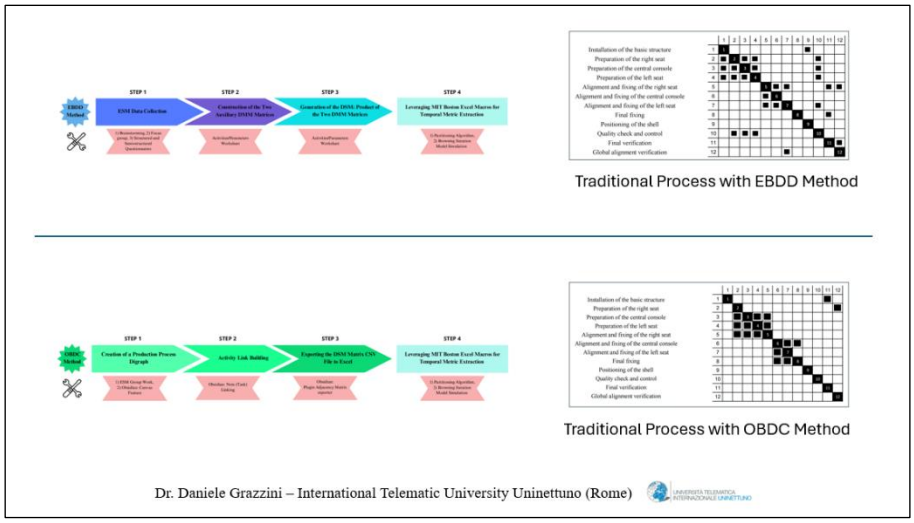
The idea underlying the newly introduced spreadsheet is shown in this slide. The DSM matrix is produced through a process explained in detail in the instruction manual contained in the GitHub address mentioned in the article.



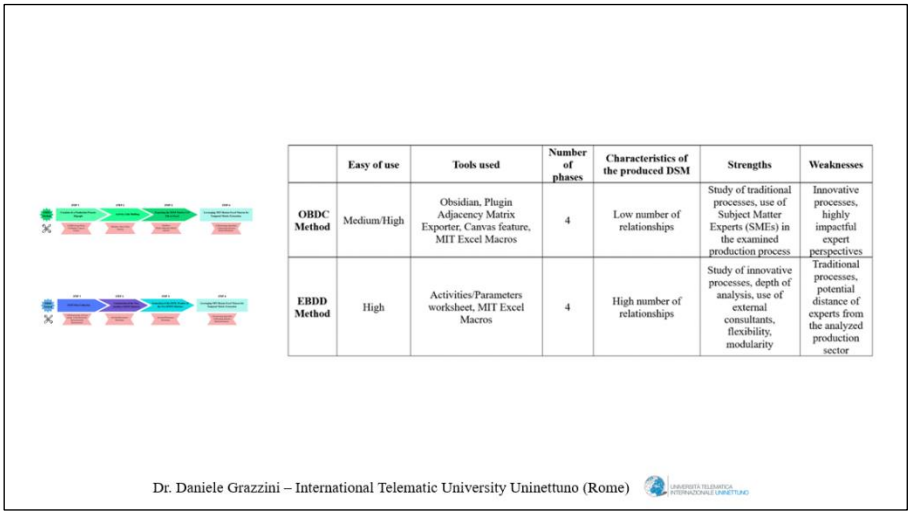
We proposed two concurrent methodologies called EBDD (Excel-based DSM Development) and OBDC (Obsidian-based DSM Creation) for analyzing a production process of interest. Both of them consist of 4 stages and have in common the starting point i.e. the group work of ESMs (expert Subject Matter).



In order to grasp the peculiarities of each method, we analyzed the traditional process and the innovative process with the same methodology, arriving at a result in terms of the time metric. The data tables show the result. The image depicts also the calculation process with the use of Excel sheets from MIT Boston.



The comparison among the two methodologies has been made throughout the corresponding DSM matrices for the production process.



	Easy of use	Tools used	Number of phases	Characteristics of the produced DSM	Strengths	Weaknesses
OBDC Method	Medium/High	Obsidian, Plugin Adjacency Matrix Exporter, Canvas feature, MIT Excel Macros	4	Low number of relationships	Study of traditional processes, use of Subject Matter Experts (SMEs) in the examined production process	Innovative processes, highly impactful expert perspectives
EBDD Method	High	Activities/Parameters worksheet, MIT Excel Macros	4	High number of relationships	Study of innovative processes, depth of analysis, use of external consultants, flexibility, modularity	Traditional processes, potential distance of experts from the analyzed production sector

All the analysis has been summarized in a table highlighting the tools used, the characteristics of the corresponding DSM produced, their strengths and weaknesses. We want to stress the fact that the OBDC method seems to be more suitable for studying traditional-type processes where Subject Matter Experts are also experts in DSM theory, while the EBDD method seems to be more suitable for studying innovative processes and can effectively involve professionals who are not experts in DSM theory. The difference that results from applying the methods to the same matrix should prompt the project manager to focus on the purpose he or she is pursuing in order to select the one that best suits the needs of his or her study.

26TH INTERNATIONAL DEPENDENCY AND STRUCTURE MODELING CONFERENCE, DSM 2024
STUTTGART, GERMANY, 24 – 26 SEPTEMBER, 2024

Thank you for your attention!

"Development of a method for comparing industrial processes using DSM: application to a case study in the automotive sector, the SeatBridge patent"

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PHOTO GALLERY