

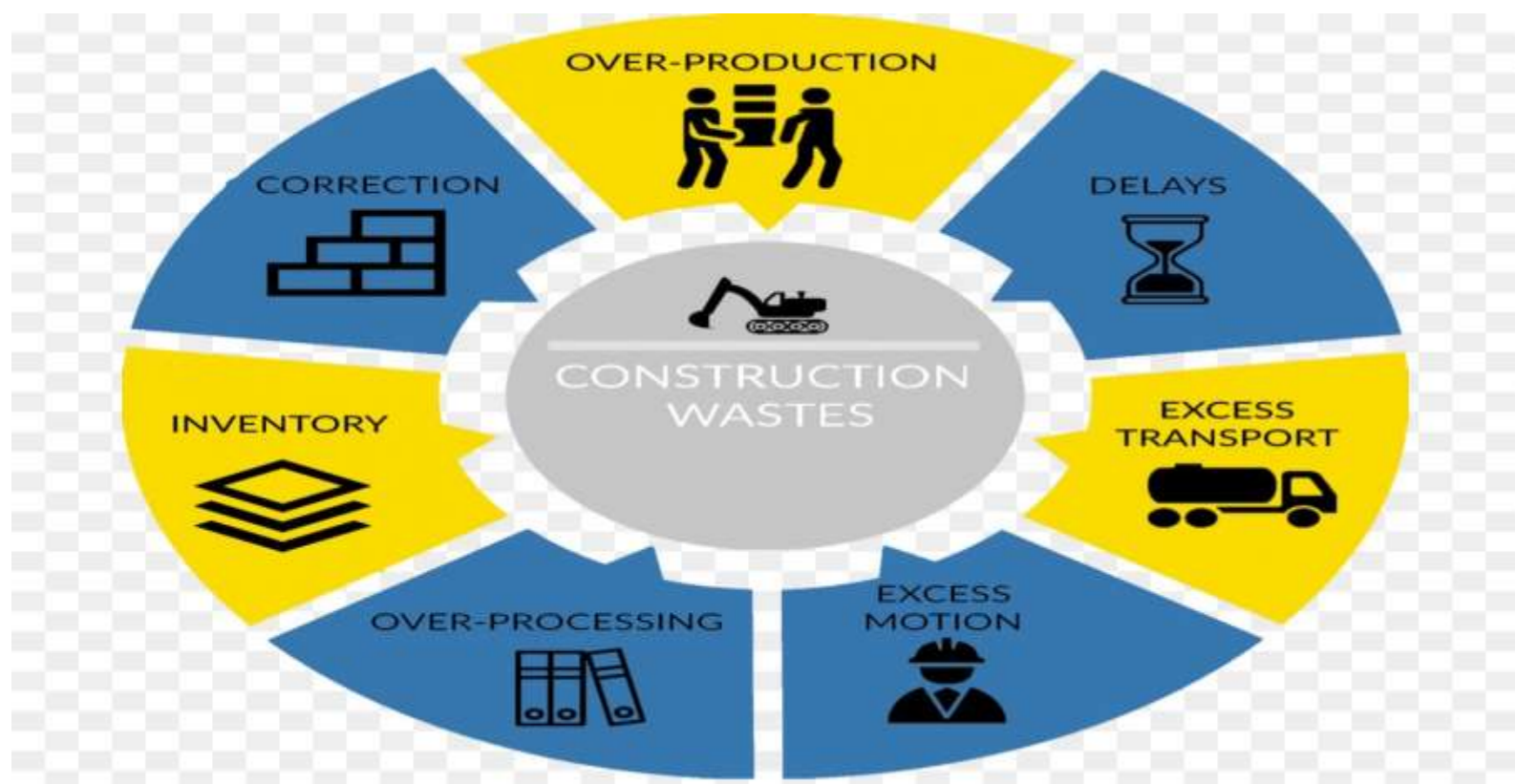
Key factors affecting the implementation of Integrated Project Delivery for Lean Construction

AUT

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1. Lean Construction (LC)

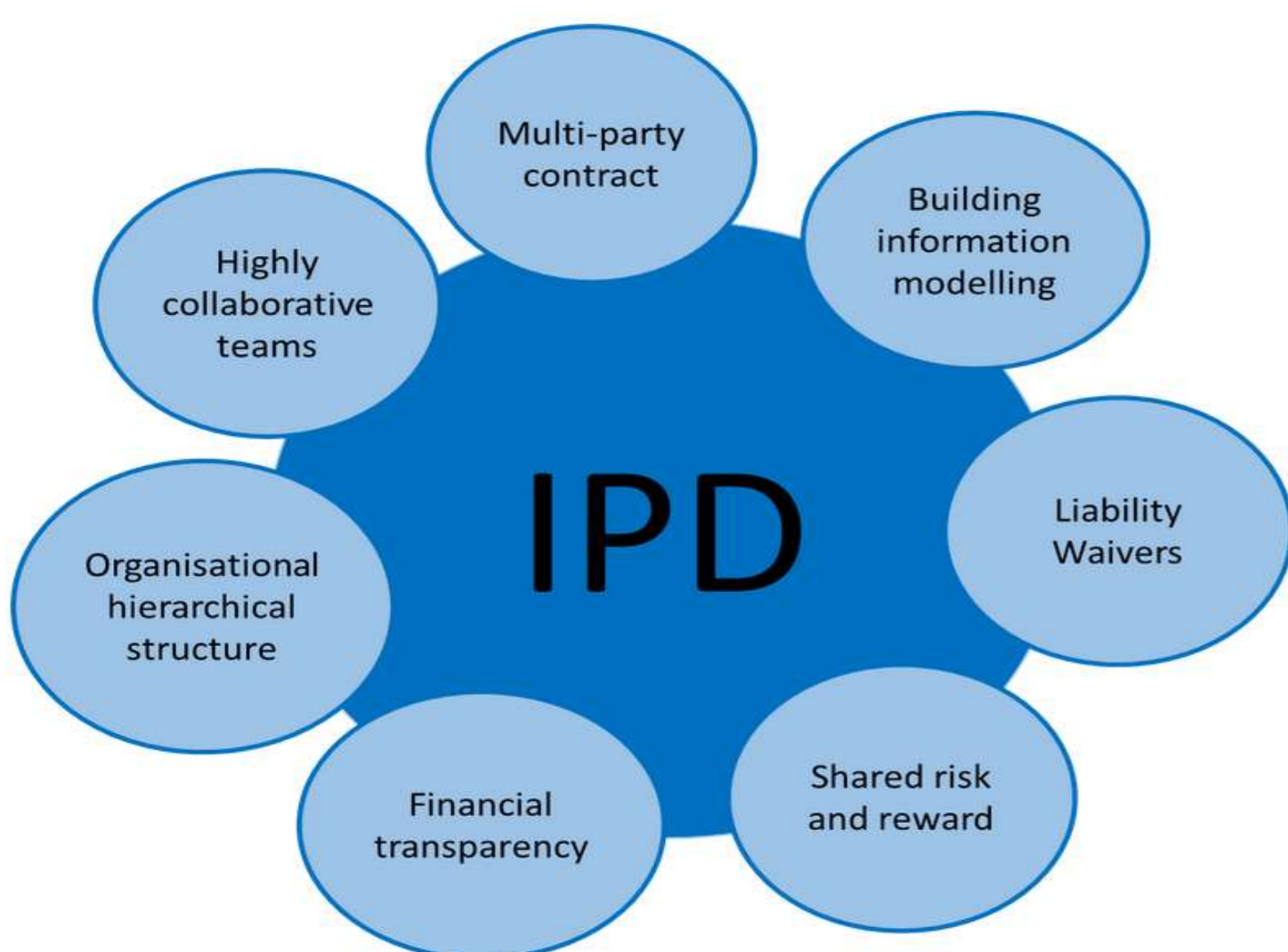
In construction, lean prioritises refining a project's processes and delivery methods to better meet the owner's needs through eradicating waste and non-value-adding activities (Ghosh and Burghart, 2021).



(Dream Civil, 2023)

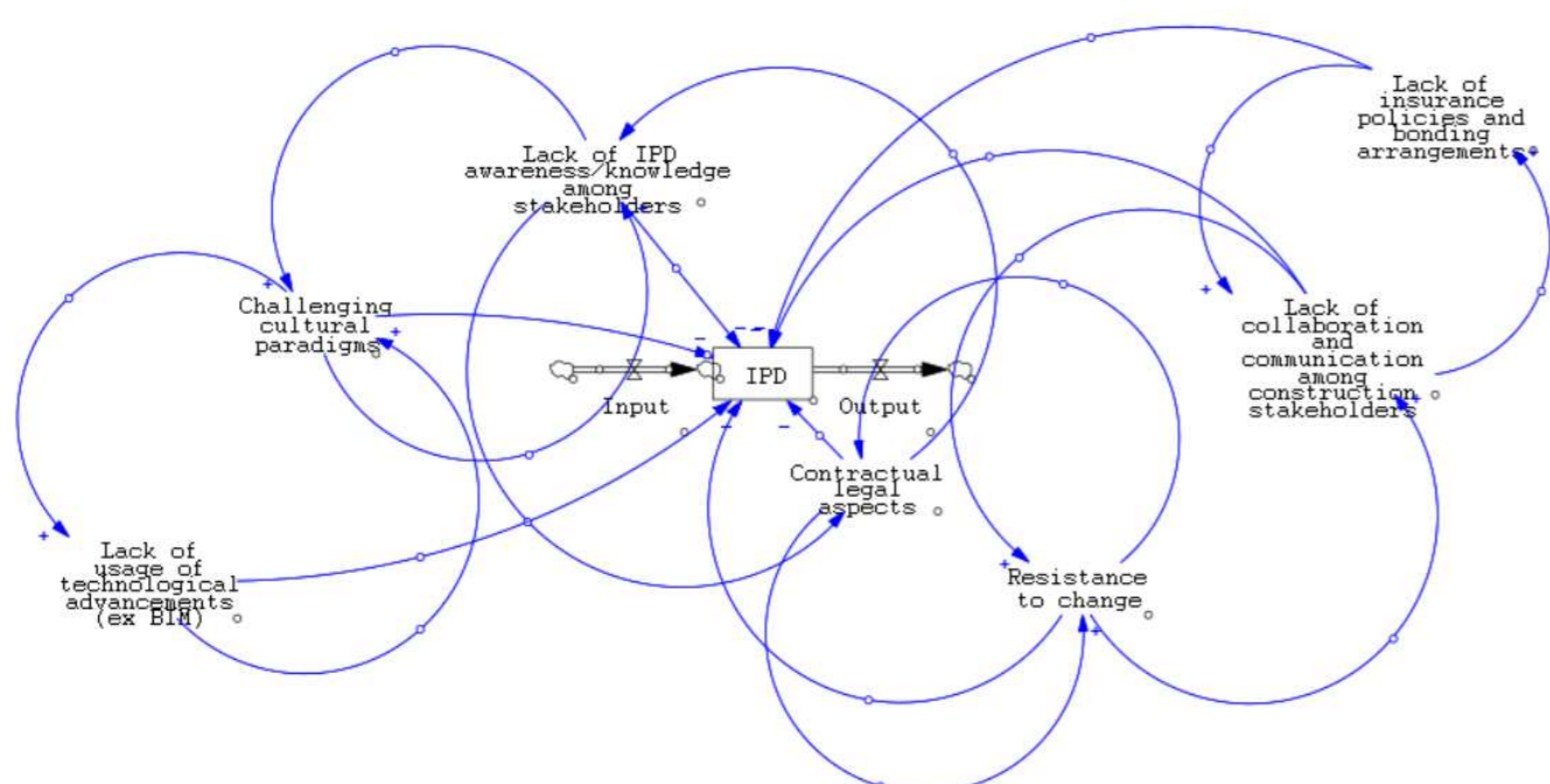
2. Integrated Project Delivery (IPD)

IPD is the practical application of lean- a contracting method that sets the rules for a project (Kuchera, 2015). The characteristics of IPD are shown below:



(Buk'hail and Al-Sabah, 2022)

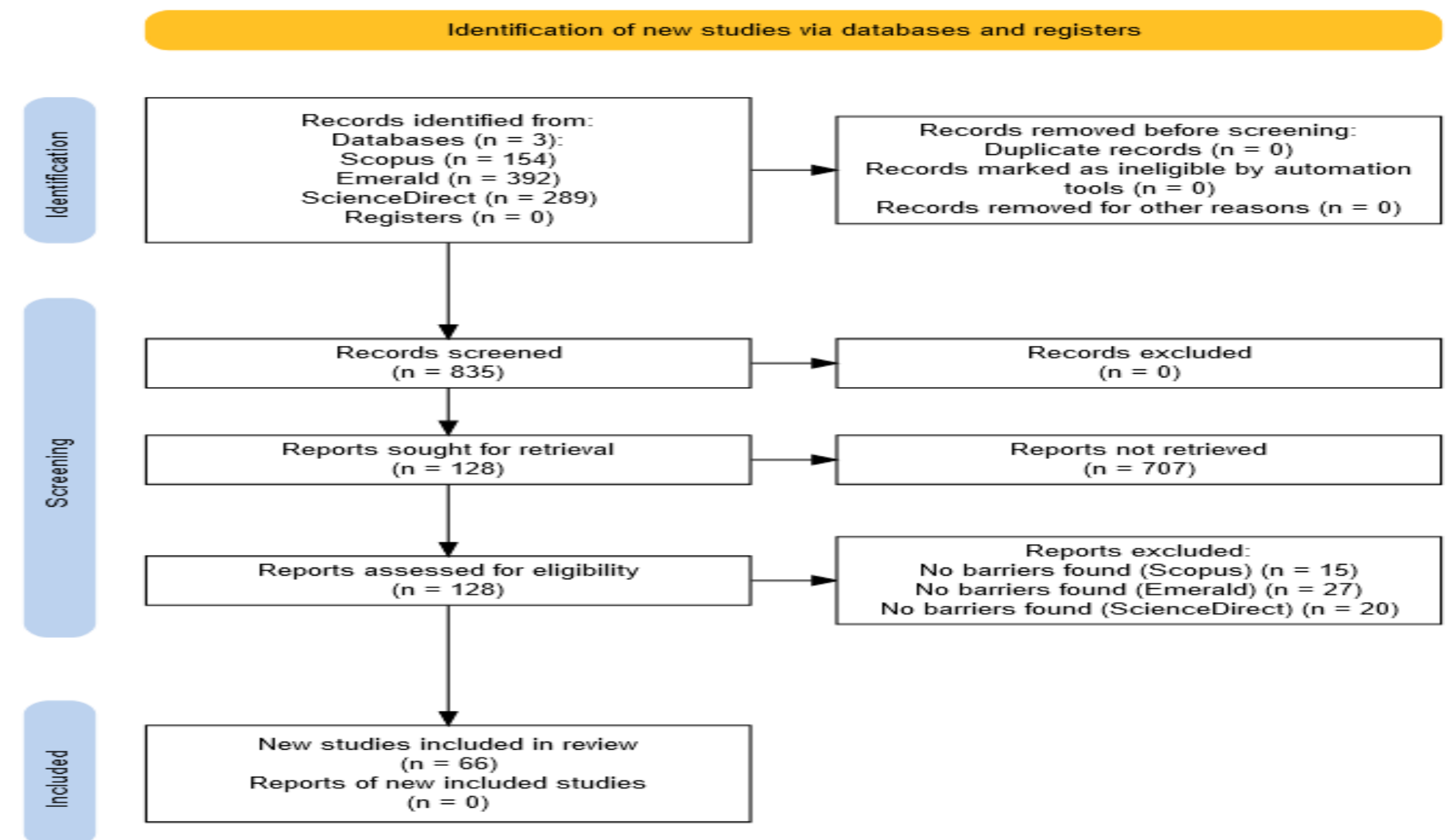
5. Causal Loop Diagram



The top 7 barriers to IPD (more than 20 author references) are: (1) lack of usage of technological advancements (ex BIM), (2) challenging cultural paradigms, (3) lack of IPD awareness/knowledge among stakeholders, (4) contractual legal aspects, (5) resistance to change, (6) lack of collaboration and communication among construction stakeholders, and (7) lack of insurance policies and bonding arrangements. The Causal Loop Diagram shows how these top 7 barriers influence one another.

3. Systematic Literature Review

A systematic literature review (SLR) was conducted to identify all existing barriers to IPD in literature using three key databases- Scopus, Emerald, and ScienceDirect. The PRISMA chart for the SLR process is shown below:

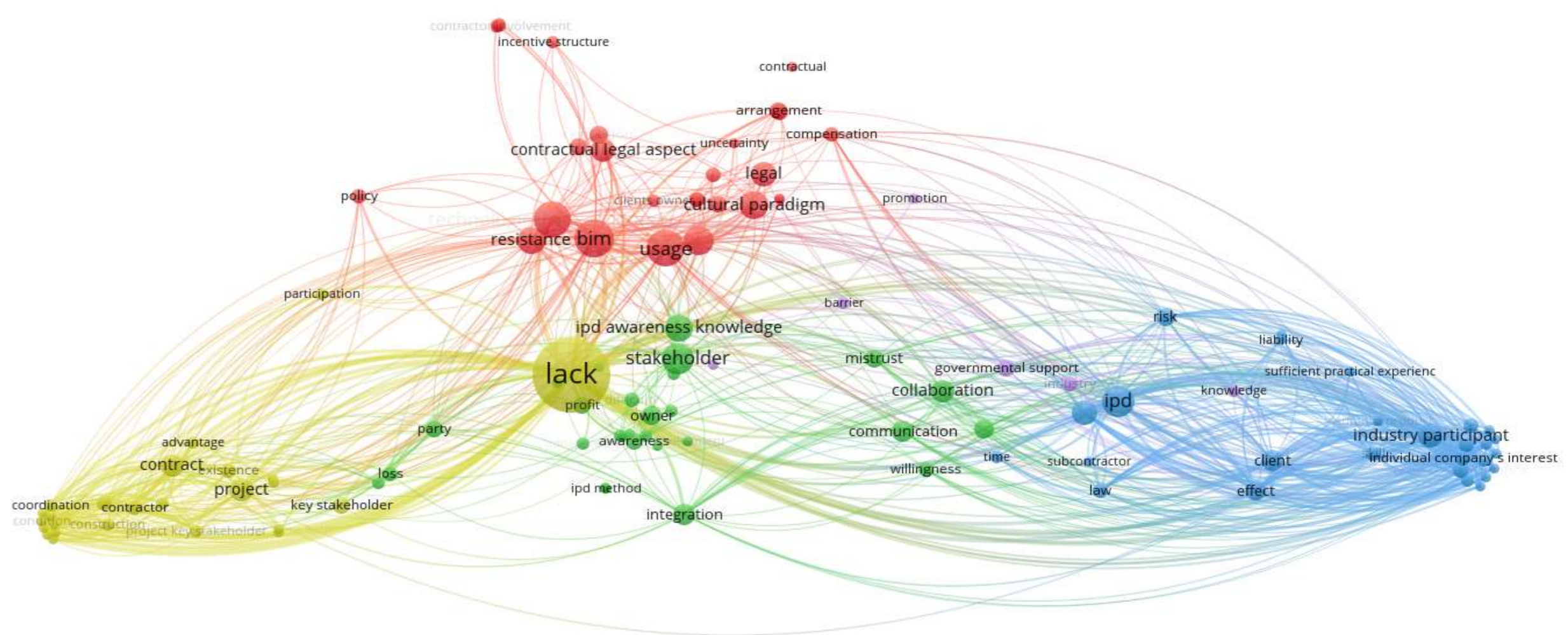


(PRISMA Flow Diagram, 2022)

One hundred and twenty-eight articles were selected from the SLR, out of which 66 had either explicitly or implicitly mentioned the barriers.

4. Key barriers to IPD

Two hundred and twenty-two barriers to IPD were found from the 66 articles. Using the text mining functionality of VOSviewer, all barriers were uploaded to the software in a text document to visualise the co-occurrence of factors. The result from VOSviewer is shown below:



The VOSviewer diagram displays the connectivity between factors. The VOSviewer identifies and connects the most common barriers to IPD from the total 222 barriers found in the SLR. The results from VOSviewer group the barriers into five colour categories indicating the connections between the factors. Additionally, the link between barriers reveals the strength of the relationship- the thicker the connection, the stronger the relationship between those barriers. The barriers in red are contractor involvement, incentive structure, contractual, contractual legal aspect, arrangement, compensation, uncertainty, legal, cultural paradigm, resistance, BIM, and usage. The barriers in yellow are lack, project, key stakeholder, advantage, contract, existence, coordination, and contractor. The barriers in green are IPD awareness/knowledge, stakeholder, mistrust, collaboration, communication, owner, IPD method, integration and willingness. The barriers in blue are risk, liability, time, law, client effect, sufficient practical experience, industry participant, and individual company's interest. The barriers in purple are governmental support, industry, knowledge, and promotion. It is also pertinent to know that the larger the font of a barrier, the more significance it has. The barriers in the red colour category can be categorised into cultural paradigms, resistance- either because of contractual legal aspects, financial matters such as compensation or incentive structure, or BIM usage required. The barriers in yellow can be categorised into a lack of several essential requirements- it is clear that lack is the largest font out of all the barriers displayed. In particular, the lack of coordination between key stakeholders and the lack of an existing IPD contract seem to be significant barriers. The barriers in blue can be categorised into a lack of sufficient practical experience regarding IPD, individual interests of project stakeholders, and risk and liability being major barriers to capturing a client's interest in implementing IPD. The barriers in green can be categorised into a lack of IPD awareness and collaboration issues- specifically, a lack of communication and mistrust between project parties. Finally, the barriers in purple can be categorised into a lack of governmental support and a lack of promotion of IPD.