



## Feasibility Study of Application Building Information Modelling and Integrated Project Delivery to Improve the Operation of Communication Management and Project Integrated Management

Homa Bahmani\*

Architecture and Urban Design Faculty of Shahid Beheshti University,  
Iran

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**Abstract:** According to the research conducted in the National Institute of Standard and Technology<sup>1</sup> in 2004, 15.8 million dollars (\$) is lost annually in the United States construction industry, since the fragmented construction environment does not use the coherent technology to meet stakeholders' expectations. This fact resulted from lack of integration in building projects, utilizing inappropriate technologies and neglecting the importance of communication among members of the project team. Although such new technologies as Building Information Modelling (BIM) and new delivery methods like Integrated Project Delivery (IPD) have been recently used in this gamut, using their interrelationship for improving the conditions of construction projects has been disregarded. The objective of this article was to perform a feasibility study on the utilization of BIM and IPD, which may cause improvement in communication and integration management which are the two important parts of knowledge among the ten fields in the Project Management Body of Knowledge (PMBOK). In this regard, researchers made effort to find an intersection between communication management and project integration management (being an effective factor in developing the construction industry) as well as BIM and IPD (as facilitators for expansion of communication management and project integration). According to what aforementioned above, this article is rummaging the role of people, systems and projects in integrating project management by considering literatures gathered from library studies.

**Keywords:** Building Information Modelling, Integrated Project Delivery, Integration management, Communication management, Technology.

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### I. INTRODUCTION

BIM is somewhat radical and contrary to the industry's understanding of the relationship between the two technologies as articulated by the AIA (2007), which states, "BIM provides a platform for collaboration throughout the project's design" (Benedict D & David J, 2012).

A new project delivery, called Integrated Project Delivery (IPD), is a workflow which utilizes new technologies such as BIM. It defines business structures and processes which empower the project participants to contribute with their knowledge and expertise earlier than traditionally. This early integration gives all team members the opportunity to realize better their highest potentials, to employ their talents and insights in a collaborative way in the design process and to expand the value which they can provide throughout the project lifecycle (KARATHODOROS & BRYNJÓLFSSON, 2013).

The concept of integration is wide scale, personal, technical, organizational, interpersonal and informational but the core idea of integration is based on the connection and alignment. Both internal and foreign projects must be integrated. Internal integration means that the project work packages, deliverables and systems are linked with each other. External integration means that the buyer has a line connecting project with the systems and produces the value for the buyer and the industry (Bruce, 2006).

In addition to role of the integration of IPD, strong communication between stakeholders is necessary for the implementation of projects by IPD. Indeed, correct understanding of each party to the other by the use of usual maps is not simply possible. Technology Building Information Modelling Technology is known as one of the most important tools in communication between agents involved in the project. The high level of cooperation needed in IPD projects, necessitates using BIM in these projects, so that they can be considered almost impossible without BIM. For this reason the same contracts published such as C191, clearly emphasis on the use of BIM in project management (Bruce, 2006). Unfortunately, despite of the many benefits of BIM in project management, yet it has not been much attention in Iran (Shah Hosseini, Hajarolasvadi, Naderi, & Joshani, 2013)

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<sup>1</sup>NIST

In the recent century, development of new technologies affected all other sciences such as Electronic, Mechanics and so forth, but the construction industry was neglected in this field and lack of utilization of new technologies is remarkable now. On the other hand, complex projects require suitable technologies which will be able to answer their needs. Indeed, improving the knowledge and techniques which are used in construction projects necessitate that all participants in projects use modern technologies such as BIM. In this way, construction projects should be updated in all aspects of projects, so they will need a new method of delivery system which can boost communication and integration which are characteristics of BIM. Furthermore, IPD as a delivery system should be regarded as a collaborator that will help BIM to enhance communication and integration management in projects.

## II. LITERATURE REVIEW

### 2.1 BIM:

Building information modelling (BIM) is a relatively new technology in the commercial construction industry. Eastman, Teicholz, Sacks and Liston (2008) defined BIM as an electronic replica of a project that, “contains precise geometry and relevant data needed to support the construction, fabrication, and procurement activities” (Benedict D & David J, 2012)

BIM classification includes:

- BIM As a product.
- BIM as IT, open standards based on deliverables and cooperation process.
- BIM As the requirement of facility management of project life cycle.

BIM as a product refers to building information model which is a digital performance of information. BIM as IT refers to building information modelling. BIM is considered as a process developed and used for increasing the project's usability. This process also leads in enhancement of collaboration and harmony among the other activities' roles (KARATHODOROS & BRYNJÓLFSSON, 2013).

BIM as Facilities management requirement of the project life cycle refers to building information management considered as a method focusing on sharable information for managing information. Furthermore, this method also leads in growth of Ways of information flow through building lifecycle (KARATHODOROS & BRYNJÓLFSSON, 2013).

The following table shows level of details in every level of BIM application.

Table 1-Level of Detail in BIM-( KARATHODOROS & BRYNJÓLFSSON, 2013)

Design phase	BIM models
Existing condition model Site Analysis Space program Design authoring – Volumetric Model Zoning and Orientation	Pre- Schematic (LOD 100)
Design Authoring- Preliminary model Sustainability (LEED) evaluation Programing Phase Planning Preliminary Cost Estimate Design Review Preliminary 3D coordination	Schematic (LOD 200)
Design Authoring model Sustainability (LEED) analysis Detailed Energy analysis System cost estimates 3D coordination reporting Program Validation	Design Development (LOD 300)
Design Authoring – final model 3D coordination validation Cost estimation Sustainability (LEED) reporting	Construction Documents (LOD 400)
Construction System design Phase planning Digital fabrication Record Modeling Asset management	Services during Construction (LOD 500)

### 2.2. Integrated Project Delivery:

Integrated Project Delivery (IPD) is a method of managing large-scale construction and development projects. It is formal collaboration that occurs throughout the design, planning, and execution phases of a project. The goals of IPD are

to assist owners, designers and constructors in reducing waste, cutting costs, and improving productivity (AIA, 2007). The American Institute of Architects (AIA, 2007) defines Integrated Project Delivery (IPD) as, "... a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction" (Benedict D & David J, 2012).

Traditional delivery and contracting approaches contemplate separate silos of responsibility that, in practice, yield inefficiencies whenever there is a hand-off from one silo to another. Additionally, projects delivered traditionally suffer because participant success and project success are not necessarily related. Indeed, it is quite possible for one or more project participants to "succeed" notwithstanding overall project failure. IPD, however, represents a behavioural sea change in the industry by breaking down the silos of responsibility, requiring close cooperation among all major participants, and aligning participant success to project success.

IPD strategically realigns participant roles, underlying motivations, and sequences of activities on a project to utilize each participant's best talents and abilities at the most beneficial moment. Success is project-centric under an integrated delivery approach and relies on collaboration. The focus is on collectively achieving shared goals rather than meeting individual expectations. Success is measured by the degree to which common goals are achieved (AIA California Council & AIA National, 2007).

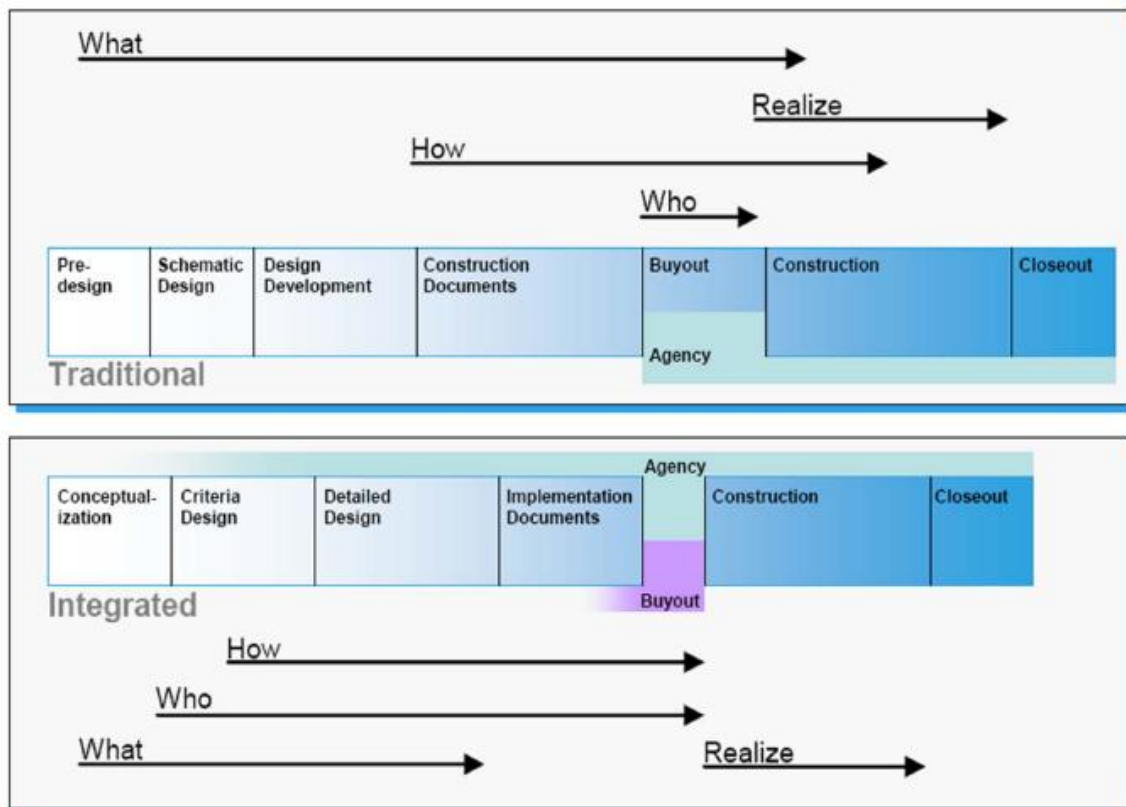


Fig 1- mplimentation Phases of IPD-(AIA California Council & AIA National, 2007).

In addition to shifting design decision making forward, redefinition of phases is driven by two key concepts: the integration of early input from constructors, installers, fabricators and suppliers as well as from designers; and the ability to model and simulate the project accurately using BIM tools. These two concepts enable the design to be brought to a much higher level of completion before the documentation phase is started. Thus the first three phases of the integrated project: Conceptualization, Criteria Design, and Detailed Design (described in detail on the following pages) involve more effort than their counterparts in the traditional flow (Nejati, 2013)

This higher level of completion in earlier project stages means that the next phase, Implementation Documents, requires less effort than the traditional Construction Documents phase, and the early participation of regulatory agencies, trade contractors, and fabricators allows shortening of the fifth and sixth phases, Agency Review and Buyout, as well. The result is that the project is defined and coordinated to a much higher level prior to construction start than is typical with traditional delivery methods, enabling a more efficient Construction phase and a potentially shorter construction period. The IPD phases conclude at project Closeout (Nejati, 2013).

### 2.3. Communication and Integration Management:

The term communication originates from the Latin word communicate, which means 'to make common', and when communicating, a common understanding is created. Barrett defines communication as: "the transmission of meaning from one person to another or many people, whether verbally or non-verbally". The single most significant factor affecting the success of a project is the communication ability of the project manage.(Zulch, 2014).

Communications Management includes the processes required to ensure the timeliness and appropriateness of planning, collection, creation, distribution, storage, retrieval, management, control, monitoring and finally displacement of project information. Project managers spend most of their time in connection with the project team, project managers and other stakeholders on their projects, whether they are inside (in all organizational levels) or outside the organization. Effective communication creates a bridge between various stakeholders that may have organizational and cultural backgrounds, different levels of expertise, perspectives and different interests that may have influence on the project or its outputs (Zokaee, 1999)

Communication can be regarded as the substance of everyday organizational life. It is an essential aspect of the functioning of an organization as well as its information exchanges with its environment. Thus organizational communication can be considered in either internally or externally defined terms:

- The internal dimension focuses on ensuring effective communication between managers and employees and among employees in different parts of an organization. This is vital for regulating employee behavior in a way that helps to deliver on the organization's objective, for innovation in changing the way things are done, and information needed by employees to perform in their duties (Ying & Pheng, 2014).

According to the researchers, various methods of internal communications are as follows:

- ✓ Oral communication takes place in the form of meetings, discussion groups, talks, interviews, announcements and conversations, both face to face and over the telephone
- ✓ Written communication takes place by means of letters, emails, circulars, memoranda and minutes of meetings
- ✓ Non-verbal communication may convey powerful messages in the business world by means of gestures, appearance or attitudes
- ✓ Electronic communication makes it possible to send messages all over the world at a very high speed. Messages may be sent and received using computer terminals, electronic mail (email) and fax facilities
- ✓ Visual communication takes place by means of presentations, DVDs and videos (Zulch, 2014).
- The external or inter-organizational communication dimension focuses on information exchange with external parties, such as clients, local communities, trade unions, and national agencies (Zulch, 2014).

Although these two perspectives to some extent represent different kinds of processes, internal and external communication should be seen as mutually intertwined, as if one is ineffective, then the other is likely to be detrimentally affected. Thus, a failure of either communication process is likely to impact detrimentally on the organization's performance (Ying & Pheng, 2014).

Integrity management includes activities required for identify, define, blend, unique and coordination of various processes and project management activities within the project management process groups. In project management integration includes characteristics of unification, composition, communication and integration acts which are determinative for controlling the implementation of the project to completion, successfully managing stakeholder expectations and meet the requirements. Project Integration Management is creative of choices regarding the allocation of resources, the comparison between the options and competitor goals and manage dependencies between project management Knowledge areas (Zokaee, 1999)

Integration means completeness and closure, bringing components of the whole" together in an operating system. Components of a larger system, increasingly global in nature, are brought together to create performance; but what is the process of integration and how does it work generically? The answer lies in systems theory; a system is a series of parts working together with a common objective. Once the whole is defined, the analysis function breaks down the whole into its components for purposes of understanding, building, and managing the system. Integration then puts the "built components" of a system back together to create a performance model that is aligned, so that, all components work together as they were designed to (Bruce, 2006).

The integration model that follows captures the essential factors requiring a new level of integration in program and project management.

- People integrate, not systems, so people are trained to coordinate and interact with program and project participants, forming a true interdisciplinary team.
- Projects. Projects become more cross-functional as project work is defined in terms of coordination and integration of work.
- Technology. Complex products are managed at the interface, placing more emphasis on product and service integration.
- Financial, schedule, risk, and quality combined. Through earned value and integrative tools, program and project progress is seen in terms of the combined impacts on financial, schedule, risk response, and quality issues.
- Program management applications. Integration defines the program manager's role; working between top management and project managers; program managers integrate projects with company plans and strategies, and work with enterprise-wide resource management systems.
- Systems support integration. Organizational and information technology systems are designed to interface with each other and to encourage integration.

Customer is "seen" by the program team. All program and project activity is performed with the customer in full view, integrating the work with customer's expectations (Bruce, 2006)

**III. LITERATURE ASSESSMENT**

After a glimpse into the collection field of study, the researcher examined the feasibility of an IPD system and BIM, in order to facilitate communication between people involved with the integrity of the project. To evaluate the effect of these two new areas on integrity management, according to the integration model (Bruce, 2006) reviews in the areas of people, systems and projects was conducted.

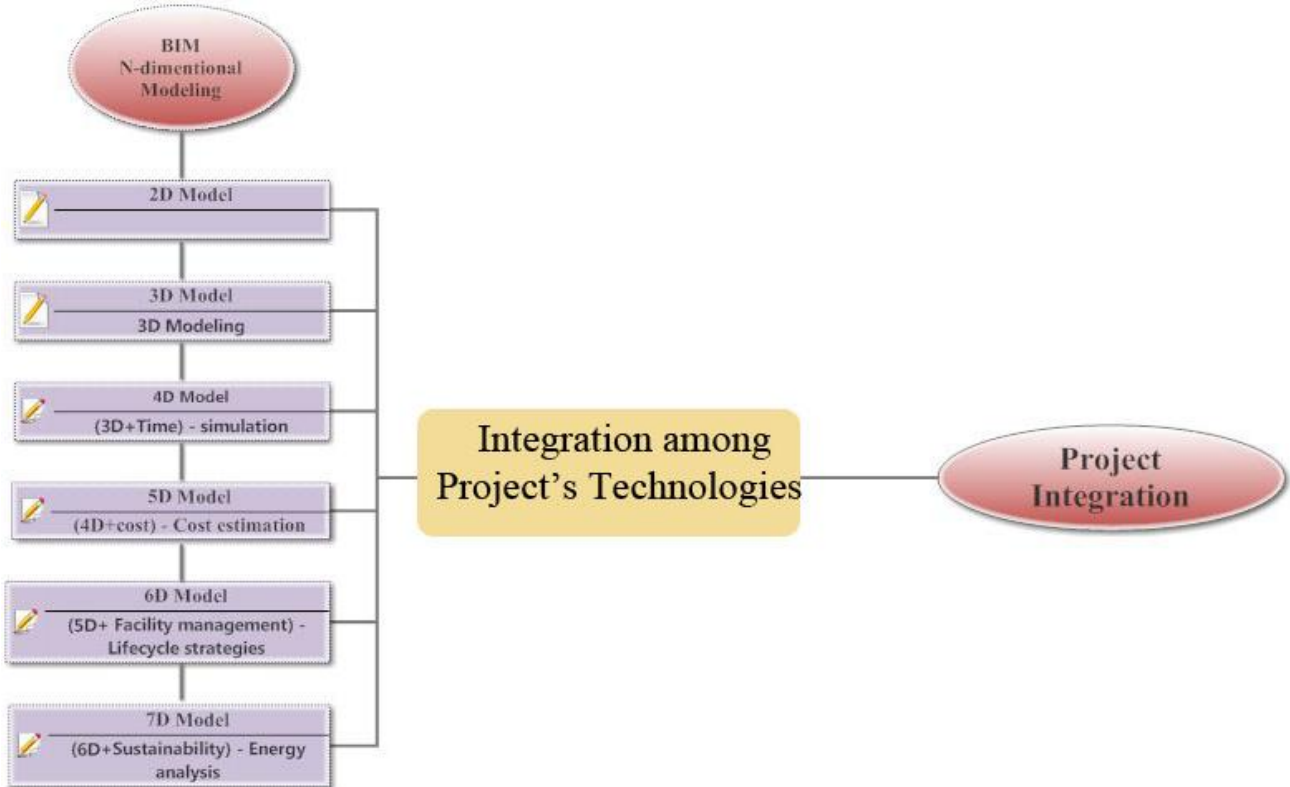


Fig 2- assessment of BIM effects on integration among project technologies

In Figure 2, the role of BIM on system integrity used in the project life cycle is examined. As described in the literature, multidirectional BIM modeling capabilities at each level which can add a new dimension to the previous level is conducive for the promotion of BIM applications. This capability enhancement will continue to the levels of project implementation, facility management and maintenance leading to integration of the technology used in the project (traditionally employer, designer and contractor), which is itself part of the model.

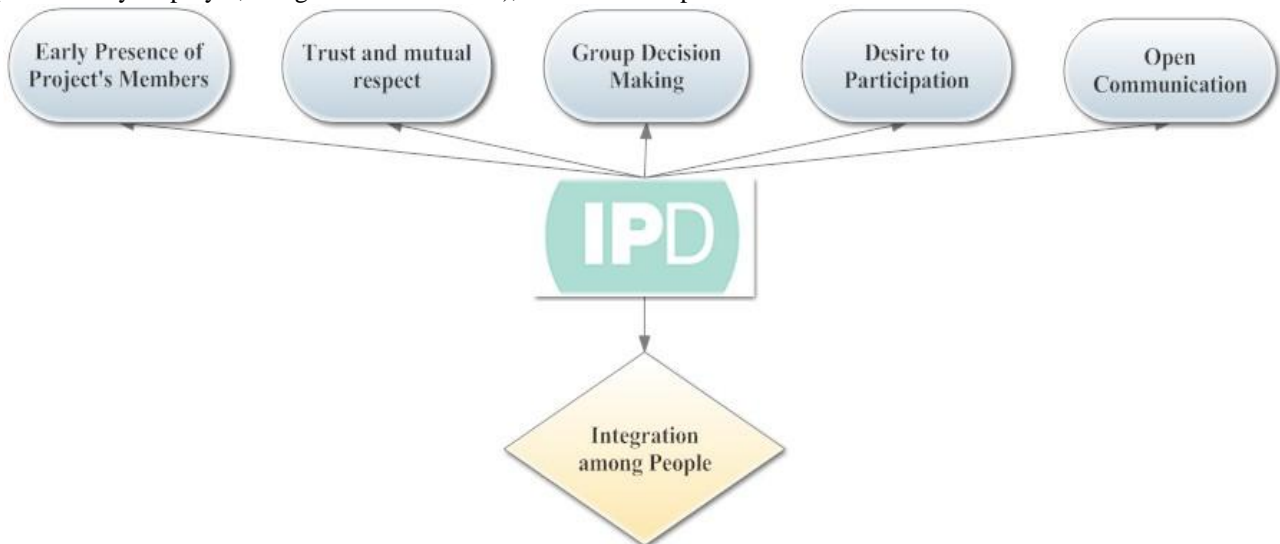


Fig 3- evaluation the relationship between IPD and integration among project members

In Figure 3, the diagram shows the direct influence of IPD utilization on integration among project people. Factors such as the early presence of persons involved in the project and their participation in decision making in the project resulted to convenient and fast information sharing which will help abate conflicts and clashes which can occur during these phases. The existence of mutual respect and trust between the people, as well as open communication and cooperation meetings will also mitigate the lodgment of individuals, project groups and organizations.



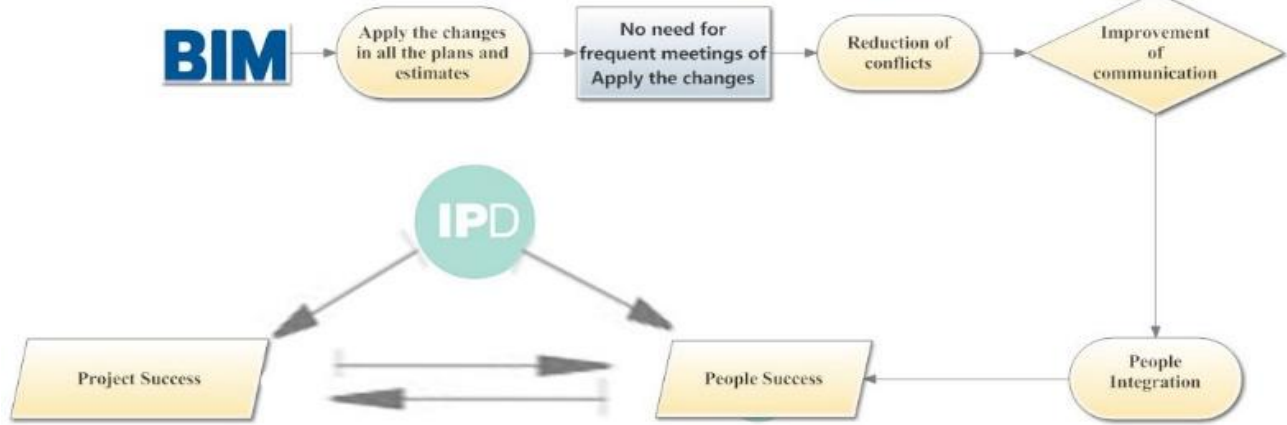


Fig 4-BIM and IPD Interaction and its effect on people integration

In Figure 4, at first the role of BIM in improving relations between project members was studied. This effect resulted in equal automatic changes in whole documents, leading to conflict diminution which can help in the reduction of inimical relationships created, owing to the subsequent change of orders. On the other hand, principles of IPD systems such as: alignment of project objectives and goals of the members engaged in the project (unlike the traditional methods of project implementation) and interoperability of BIM and IPD simultaneously enhance the chances of project and people success.

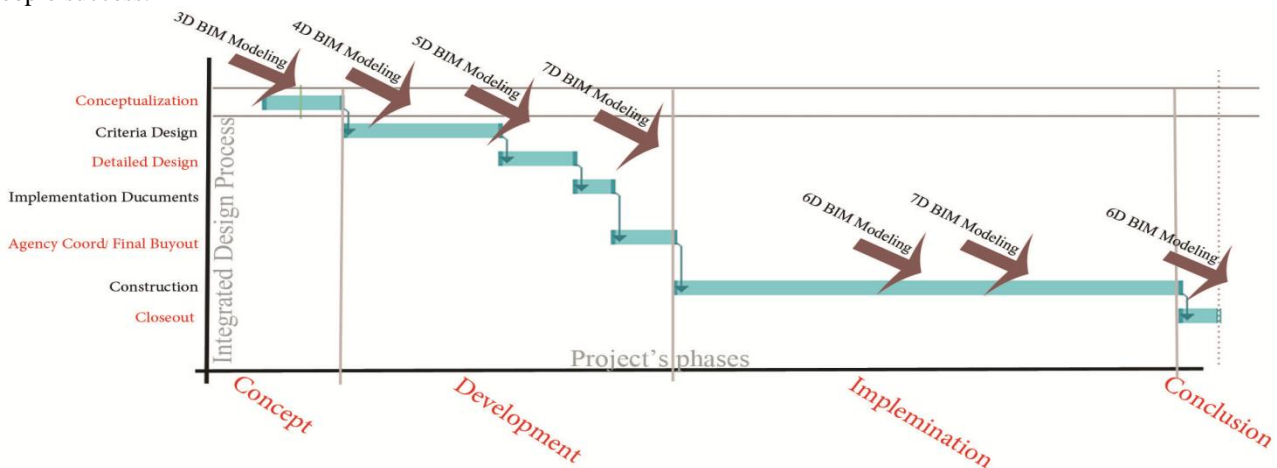


Fig 5- relationship between project phases, stages of project integration implementation and BIM's multi-dimensional modelling.

In Figure 5, the phases of project implementation were aligned with the process of integrated project design. In this part, all parts of the project integrated design have been overlapped with four main project phases including: conception, development, implementation and conclusion indicating integration at all stages of the project. Continuous BIM entrance in integrated design phases was evaluated in each level. This figure illustrates the facilitator role of BIM while using IPD which could bring about more integration.

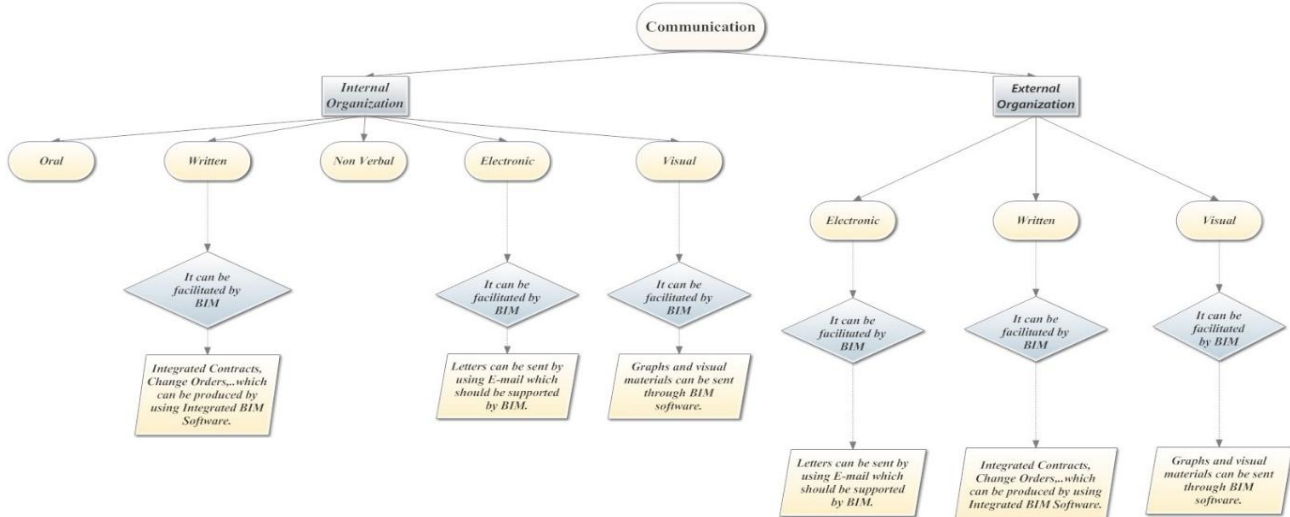


Fig 6- The role of BIM in facilitating project's communications

In Figure 6, communication is divided into two areas: inside and outside the organization that utilization of BIM can facilitate in-group and out-group communications.

#### **IV. CONCLUSION**

In this article, researchers depict intersections which are effective on each other after assessing the major areas of research which include BIM, IPD, communication project management and integration project management. This assignment which was based on the Integration Model (which was presented by Barkley T Bruce in 2006), evaluated the use of BIM and IPD simultaneously, in fields of Projects, People and Technologies. People in this model refer to person to person communication. The results of evaluation presented by means of figures and diagrams show the facilitator role of BIM in integration technologies in project and facilitating project's communication through the use of BIM, the effect of IPD on integration among people, the impact of interaction application of BIM and IPD on people integration and the facilitator role of BIM which have effect on phases of implementation of an integrated project which is corresponded with implementation project phases.

#### **V. SUGGESTED FUTURE RESEARCH**

As a whole, this paper is based exclusively on literature reviews, to illustrate the role of BIM and IPD theoretically. In future studies, researchers should assess the approach of Iran's construction industry, in application of BIM and IPD. Also, obstacles to the utilization of these new knowledge areas should be evaluated.

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