

AN INTRODUCTION OF NEW SCHEDULING SOFTWARE “BEELINER” BASED ON THE BEELINE DIAGRAMMING METHOD (BDM)

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ABSTRACT: As the construction environment has been changing all the times, the techniques for managing the construction projects have been improved accordingly. The schedule management technique, one of the construction management tools, has been evolved as well in order to be adaptable to new construction environment. Most of newly proposed scheduling techniques have been based on the Critical Path Method (CPM) that was proposed in 1956. The CPM is classified into two categories, Arrow Diagramming Method (ADM) and Precedence Diagramming Method (PDM). ADM is so good in the visual format but it cannot express the overlapping relationships between two consecutive activities. On the other hand, PDM can express the overlapping relationships but it is unsatisfactory in the visual format. Recently, as the construction environment becomes more complex and the role of schedule management becomes more and more important, the overlapping expression becomes one of critical factors for scheduling as well. Most of construction project participants prefer more comfortable visual format, however, the scheduling software based on the PDM cannot satisfy their basic requirement. Beeliner, new scheduling software based on the Beeline Diagramming Method (BDM) that was proposed in 2010, was developed in 2012, it can express more flexible overlapping relationships and has superior visual format as well. This paper presents major features and applications of Beeliner, and makes construction professionals understand new scheduling concept and its applications.

Keywords: Critical Path Method; Arrow Diagramming Method; Precedence Diagramming Method; Beeline Diagramming Method; Beeliner

1. INTRODUCTION

Critical Path Method (CPM) has gradually increased in importance in the construction industry over the last several decades. It integrates overall project management functions, such as scheduling, cost control, and resource planning. However, as the construction environment has been changing all the times, the techniques for managing the construction projects have been improved accordingly. The schedule management technique, one of the construction management tools, has been evolved as well in order to be adaptable to new construction environment. Most of newly proposed scheduling techniques have been based on the Critical Path Method (CPM) that was proposed in 1956. The CPM is classified into two categories, Arrow Diagramming Method (ADM) and Precedence Diagramming Method (PDM). ADM is so good in the visual format but it cannot express the overlapping relationships between two consecutive activities. On the other hand, PDM can express the overlapping relationships but it is unsatisfactory in the visual format. Recently, as the construction environment becomes more complex and the role of schedule management becomes more and more important, the overlapping expression becomes one of critical factors for scheduling as well. Most of construction project

participants prefer more comfortable visual format, however, the scheduling software based on the PDM cannot satisfy their basic requirement. Beeliner, new scheduling software based on the Beeline Diagramming Method (BDM) that was proposed in 2010, was developed in 2012, it can express more flexible overlapping relationships and has superior visual format as well. This paper presents major features and applications of Beeliner (version 1.4), and makes construction professionals understand new scheduling concept and its applications.

2. RESEARCH ORGANIZATION

The rest of this paper is organized as follows. First, I describe the basic concepts and principles of the BDM. Second, I present major features of Beeliner (version 1.4) developed based on BDM, and then explain how to apply it to the scheduling practices.

3. BEELINE DIAGRAMMING METHOD

3.1 Basic Concept, Principle, and Characteristics

The Beeline Diagramming Method (BDM) was proposed as a new networking technique by the author (2010). The basic concept of the BDM is to represent the overlapping relationship of two consecutive activities by

the shortest straight line; this uses an arrow to represent the direction of workflow. The BDM connects any point of the predecessor to any point of the successor. This research defines the shortest straight line, which indicates a very direct or quick path or trip, as the “beeline” (Wiktionary 2009). Fig. 1 shows the basic concept of the BDM; a beeline connects the middle point of the preceding activity A to the middle point of the succeeding activity B. The BDM has only one principle: The BDM represents the single or multiple overlapping relationships of two consecutive activities in the network by a beeline or beelines in any circumstance. Building on the basic concept and principle of the BDM, its characteristics are as follows.

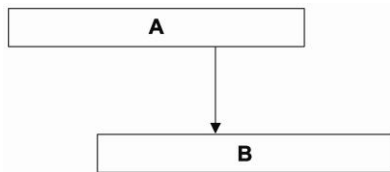


Fig. 1. Basic Concept of Beeline Diagramming Method

First, the BDM simplifies the overlapping relationships into one beeline. Thus, the complicated process of the Precedence Diagramming Method (PDM), which includes the positioning of activities, the selection of linkage types, and the calculation of the lead-time for the selected linkage, is eliminated.

Second, the BDM permits multiple overlapping relationships by means of multiple beelines between two consecutive activities. It therefore overcomes the limitations of the compound relationships found in the PDM, which has only two overlapping linkages.

3.2 Linkage Representation Types in the BDM

Linkage relationships between two consecutive activities in the BDM are represented differently from those in the PDM. Linkage relationships in the BDM can be represented at any middle point between two consecutive activities; the PDM, in contrast, represents linkage relationships only by FS, SS, FF, and SF relationships with lead-time between the starting and finishing points.

This research proposes three types of linkage representations in the BDM. The first is the “N-N” type shown in Fig. 2. This type represents two consecutive activities that are mutually connected at any point in days after their respective starts.

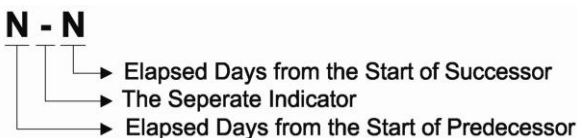


Fig. 2. Representation Type by the Elapsed Days

The initial “N” in Fig. 2 refers to the days that have elapsed from the start date of the preceding activity; the

latter “N” refers to the days that have elapsed from the start date of the succeeding activity; the “-” is the separation indicator between the two Ns. An example of the first representation type is illustrated in Fig. 3. In this Figure, two consecutive activities that have inseparable work days are connected by a “7-4” type—between a point of 7 days after the start date of the preceding activity A and a point of 4 days after the start date of the succeeding activity B.

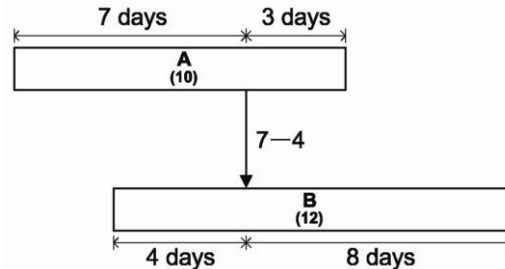
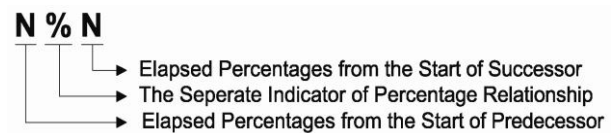


Fig. 3. An Example by the Elapsed Days

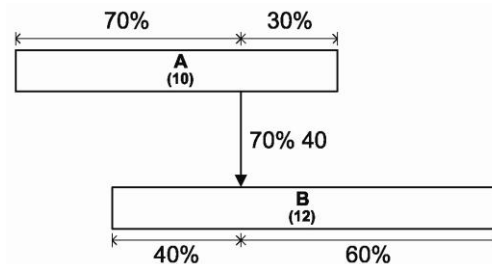
The second type is “N%N”, shown in Fig. 4. This type represents two consecutive activities that are mutually connected after any percentage of the total duration of the



two activities has elapsed.

Fig. 4. Representation Type by the Elapsed Percentages

The initial “N” in Fig. 4 refers to the percentage of time elapsed since the start of the preceding activity and the latter “N” refers to the percentage of time elapsed since the start of the succeeding activity; the “%” is the separation indicator for the percentage relationship between the two Ns. An example of the second



representation type is illustrated in Fig. 5.

Fig. 5. An Example by the Elapsed Percentages

The two consecutive activities in the BDM are connected by a “70%40” type—between a point where 70% of time has elapsed from the start date of the preceding activity A and a point where 40% of time has elapsed from the start date of the succeeding activity B.

The third is FS type, “<N>”, shown in Fig. 6, wherein the successor starts some days after the completion of the predecessor just like Finish-to-Start (FS) of PDM.

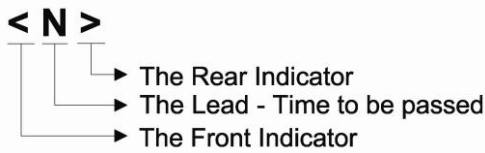


Fig. 6. Linkage Representation by FS Type

The “N” in Fig. 6 refers to the lead-time to be passed after the completion of the preceding activity. The initial “<” and latter “>” indicate the lead-time space indicators. An example of the FS representation type is illustrated in Fig. 7.

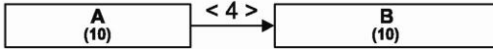


Fig. 7. An Example by FS Type

Two consecutive activities in the BDM are connected by “<4>”, wherein the succeeding activity B starts after the preceding activity A has been completed for 4 days.

The fourth type represents the multiple linkage relationships between two consecutive activities by the elapsed days or the second linkage type. Schedule computations will continue to be performed independently for each individual linkage. Fig. 8 shows an example of the two-way multiple beeline relationships between two activities that have multiple milestones.

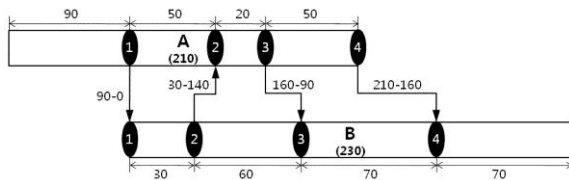


Fig. 8. Two-way Multiple Beeline Relationships

4. BEELINER

4.1 Development Goals of Beeliner

Beeliner has been developed with three goals in order to upgrade current scheduling practices and show new paradigm of scheduling. They are innovation, practicality, and convenience.

Beeliner itself has an innovation because its theoretical basis is Beeline Diagramming Method (BDM). The existing scheduling software such as Primavera and MS-Project could not solve the fundamental problems of visual expression of PDM techniques and need unnecessary options by means of version-up. General users do not use even 10% of the existing schedule software options, which means such options failed to help the practical schedule control and inversely they confused users.

Simplicity is the symbol of Steve Jobs, who was the co-founder and CEO of Apple and insisted simplicity is more difficult than complexity. Therefore, it is necessary that such unnecessary options of the existing schedule control programs are simplified in terms of convenience and practicality for users.

4.2 Major Features of Beeliner

Beeliner has a lot of unique features comparing to the existing scheduling software due to BDM characteristics. The followings are major features of Beeliner;

(1) Two-Screens Environment

Since the existing scheduling software such as Primavera (Fig. 9) or MS-Project have one-on-one connection between grid and chart parts, they cannot show a whole part of grid and chart on one screen simultaneously, therefore, a user should give up one of grid and chart if he or she wants to see one of them at a glance on one screen.

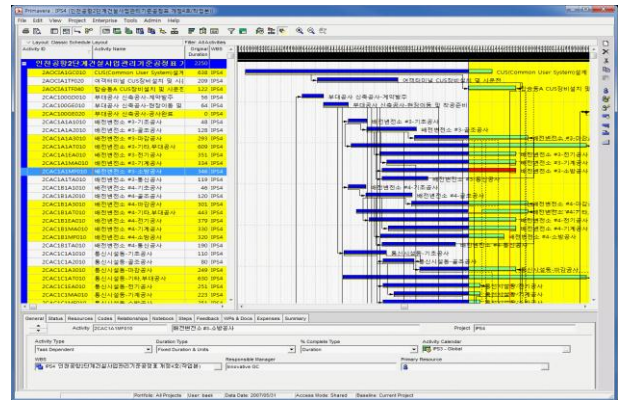


Fig. 9. Primavera’s One Screen

However, Beeliner does not match Grid with Chart one to one, so they may be separated and a user can perform a scheduling work while viewing a whole schedule chart. Beeliner shows all columns on one screen that every main process needs because Grid and Chart parts can show on two monitors separately as Fig. 10.

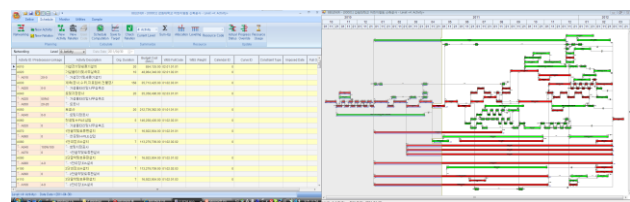


Fig.10. Beeliner’s Two Screens

(2) Automatic Activity Allocation

Beeliner places activities automatically on chart by automatic allocation logic when new activity is added. Other scheduling software does not provide such function only they can add new activity into one new row to be added below previous activity. Fig. 11 shows the result of automatic activity allocation.

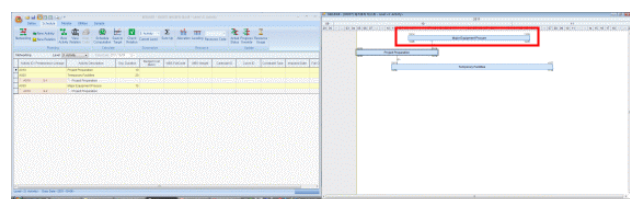


Fig. 11. Automatic Activity Allocation

Also, activities that was automatically allocated can be vertically moved to optimal location that user wants. Fig. 12 shows activities to be vertically moved from Fig. 11.

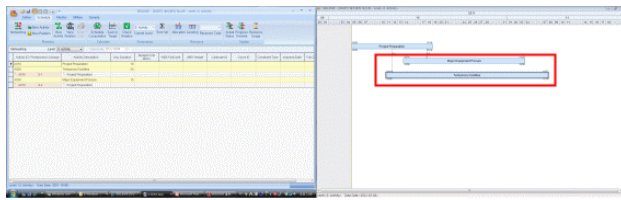


Fig. 12. Activity's Vertical Movement

(3) Visual Superiority and Overlapping

Beeliner achieves both advantages of visual superiority of ADM and overlapping relationships of PDM as well as represents overlapping relationships as elapsed percentage & two-way multiple overlapping shown as Fig. 13.

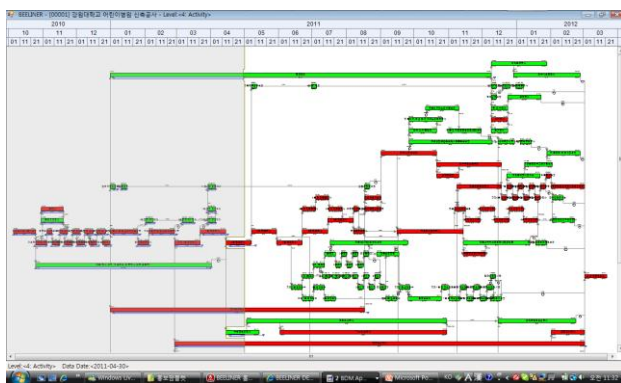


Fig. 13. Visual Superiority and Overlapping

(4) Sum-Up

Since Beeliner can express all schedules within a schedule hierarchy as same CPM format by Sum-Up function shown on Fig. 14, every project participant including a client can understand overall project flow more clearly by a summarized CPM schedule, and then make a decision so quickly and efficiently.

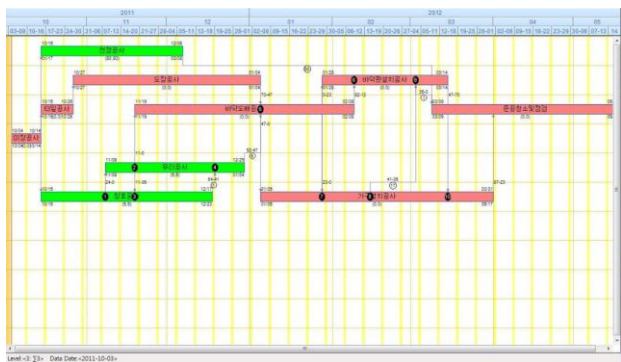


Fig. 14. Summarized CPM Schedule

(5) Progress Override and Schedule Comparison

Progress Override and Schedule Comparison functions of Beeliner shown on Fig. 15 can make project team

understand overall delays exactly and establish more suitable schedule recovery plan.

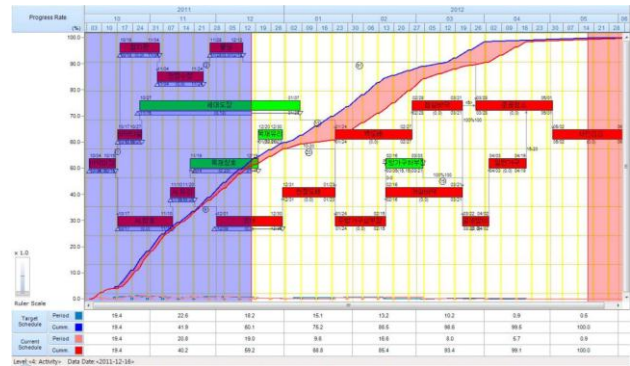


Fig. 15. Progress Override and Schedule Comparison

(6) Integration of Multiple Projects

Master Project function of Beeliner shown on Fig. 16 can integrate multiple sub-projects of mega project into one CPM network for controlling a whole project more conveniently.

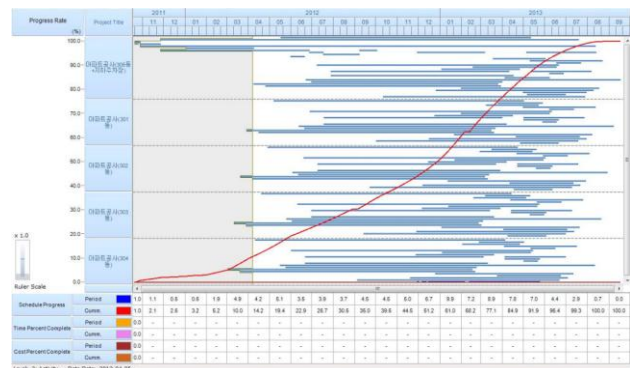


Fig. 16. Master Project

4.3 Applications of Beeliner

Beeliner provides a lot of benefits for improving schedule management procedures. The followings are some of key benefits that could be earned when Beeliner is applying.

(1) Verify CPM Schedule

Beeliner can help to verify CPM schedule that was established by PDM technique. PDM network usually produces a lot of unnecessary relationships, called redundant relationships in other word, because their activities are listed vertically downward direction against time axis. Beeliner almost never expresses unnecessary relationships because their activities represent their activities as horizontal direction with time axis. Steps of verifying CPM schedule are follows (refer to Fig. 17);

- 1) Convert PDM schedule to BDM schedule
- 2) Review suitability of activities' logic, and remove unnecessary logics

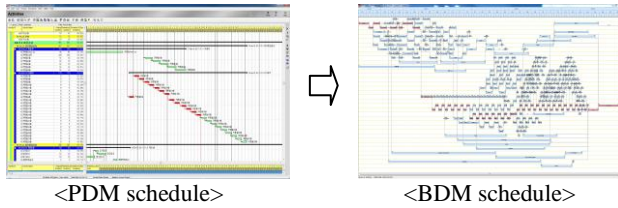


Fig. 17. Verify CPM Schedule

(2) Summarizing CPM Schedule

Sum-Up function provides more accurate schedule status to major project participants including a client by summarizing CPM schedule. Steps of Sum-Up are follows (refer to Fig. 18);

- 1) Summarize CPM schedule from lower to upper level by Sum-Up function
- 2) Upper level schedule shows a CPM schedule with two-way multiple overlapping relationships between summarized activities.

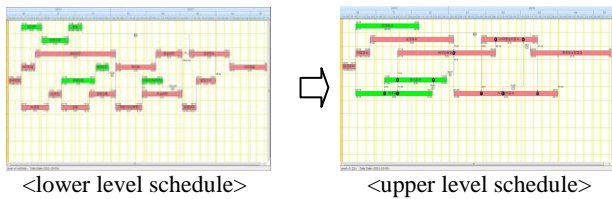


Fig. 18. Summarizing CPM Schedule

(3) Distinguish Progress Status

Activity progress status is distinguished by regions of completed and uncompleted activities based on Data Date line clearly in visual format (refer to Fig. 19).

- 1) Data Date line is changed to zigzag line when actual progress is input.
- 2) Left of Data Date line is a region of completed activities as colored. Right of Data Date line is a region of uncompleted activities as uncolored.

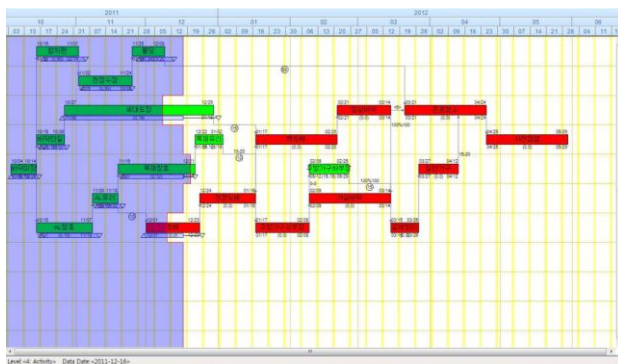


Fig. 19. Distinguish Progress Status

(4) Progress Override

Progress Override function makes to understand schedule status more clearly, and then establish more efficient schedule recovery plan (refer to Fig. 20).

- 1) If executing Progress Override, move delayed activities to the right direction, and early activities to the left direction.

- 2) Data Date line is aligned to vertical straight line from zigzag.

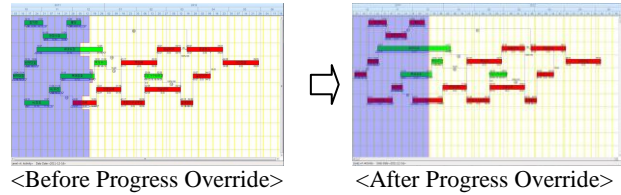


Fig. 20. Progress Override

(5) Compare Schedules

Schedule comparison function provides to comprehend differences between target and current schedules exactly in visual format (refer to Fig. 21).

- 1) Select target schedule, and then compare target and current schedules.
- 2) If there are some differences between target and current schedules, they are expressed by gaps to be filled as red color if current is delayed against target, and green color if current is earlier than target.

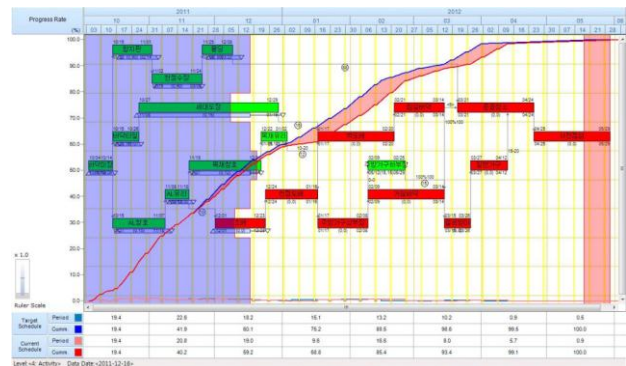


Fig. 21. Compare Schedules

(6) Integrating Multiple CPM Schedules

Master Project function provides to integrate multiple CPM schedules into one CPM schedule (refer to Fig. 22).

- 1) Establish multiple CPM sub-networks according to buildings or areas of mega project.
- 2) Integrate multiple sub-networks into one CPM schedule by Master Project function, and then view the integrated plan and actual status as a whole.

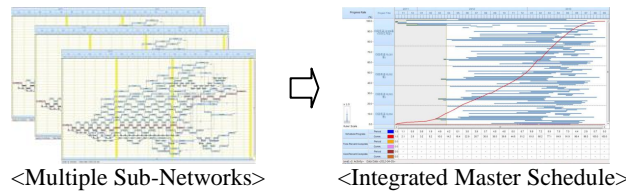


Fig. 22. Integrating Multiple CPM Schedules

(7) Realize Paperless Schedule

Beeliner realizes paperless schedule by separating Grid and Chart parts on two monitor (refer to Fig. 23).

- 1) Separate Grid and Chart parts on two monitors independently.
- 2) Then, projecting Chart part to a big screen by high definition beam projector or HDTV.

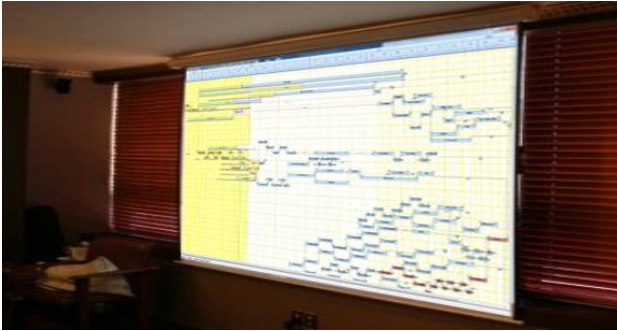


Fig. 23. Realize Paperless Schedule

Conference on Construction Engineering and Project Management, Sydney, Australia, 2011

[3] Kim, Seon-Gyoo, et al, "The Concept of Schedule and Cost Progress Integrated Management on the BDM network", *Korean Journal of Construction Engineering and Management*, November, Vol1 12(6), pp. 54-64, 2011.

[4] Kim, Seon-Gyoo, et al, "Schedule Computation Method of Two-way Multiple Overlapping Relationships on BDM Technique", *Korean Journal of Construction Engineering and Management*, March, Vol1 13(2), pp. 120-127, 2012.

[5] Kim, Seon-Gyoo, et al, "Method of Transforming PDM Overlapping Relationships to BDM Overlapping Relationships in CPM Schedule", *Korean Journal of Construction Engineering and Management*, September, Vol1 13(5), pp. 144-152, 2012.

5. CONCLUSIONS

Beeliner's innovative features and applications, that has been developed based on BDM technique, can make construction professionals perform more enhanced scheduling works. The followings are some of expected effects of Beeliner.

- 1) Since BDM technique expresses the most favorable schedule format of construction professionals, construction field engineer can make to perform schedule management more efficiently and realistically.
- 2) Various networking functions can make to establish schedule more efficiently and easily than by Excel.
- 3) Sum-Up function help to make a decision more timely and accurately about overall project schedule.
- 4) By representing regions of completed and uncompleted activities based on Data Date line, schedule status can be understood more accurately.
- 5) Progress Override can make to establish more accurate recovery schedule plan while confirming changes of project completion visually at the same time.
- 6) S-Curve, EVM, Resource Profile with background of activities' logic be understood more efficiently.
- 7) Print Chart can make to print schedules horizontally according to time axis, and provides free adjustment of sizes and details of schedules.
- 8) Mega project can be divided into multiple sub-projects, and then integrated and controlled as one CPM network.

REFERENCES

- [1] Kim, Seon-Gyoo, "Advanced Networking Technique", *Kimoondang*, South Korea, 2010.
- [2] Kim, Seon-Gyoo, "An Example of Representing Three Level's Schedules within Schedule Hierarchy by BDM Technique", *Proceedings of the International*