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Design of MEP System in Metro Railways - A Review

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Abstract

This paper illustrates the challenges for any major giant infrastructure subterranean railway project, to pick out and undertake a value effective, manageable and optimum MEP style strategy across an outsized programme of labor. The paper proposes ways to beat such challenges that extend into procurable of MEP instrumentality. The paper is meant to spotlight the need at hand over MEP design and assets that enable the Railway Operator (RO) to undertake maintenance safely and in an exceedingly price effective manner. Commonality of MEP design style in railway projects and customary element choice square measure mentioned against a non-standardized kind approach. Prototyping MEP design could be a novel approach and is wherever with multiple locations a example style strategy may be used. The design of MEP system in railways may be undertaken for one location i.e. a Station, Shaft or Portal, and so the model is employed across the programme. The paper details novel technique that is targeted at MEP systems wherever there square measure that has several similar a Station, Shaft or Portal (SSP). As this can be novel it's careful as another to a standard approach i.e. the multiple SSP locations designed at constant time. Delivery and management techniques to permit optimum performance in MEP service route and area designing and access and maintenance that can be essential to success of projects. Throughout early stages of style designers' square measure less targeted on these necessities. The paper can detail the aspects to force optimum area designing, service routes to be consummated at the acceptable time within the MEP style development stages with nominative intervention points.

Keywords – Design, MEP, Railways, RO, SSP

1. Introduction

Mechanical, Electrical and Plumbing (MEP) style on giant railway projects are delivered in many alternative ways. The strategy are being influenced from the outprojects of the acquisition strategy that is predicated on choice and award mechanisms method on the far side the main focus of the ultimate MEP providing to the artificial language [2]. Colossal Railway projects are burdened with a high level of political influence as mega projects are perpetually under the ambit of the political agenda. so selections will be made up of a political perspective instead of from associate degree Engineering one.

Large subterranean Railway projects undertake terribly long programmes and early components of construction tend to be pushed forward. It's wide acknowledged this can be the case, particularly for Tunneling and Station contracts which require fast to attain programme. This will impact the MEP quality for style and delivery, as selections will be supported Civil Assets. Performance, value and time area unit the basic parts that conjure the idea of most projects and every part must be as balanced the maximum amount as sensible to attain in project [2]. This will be seen below;

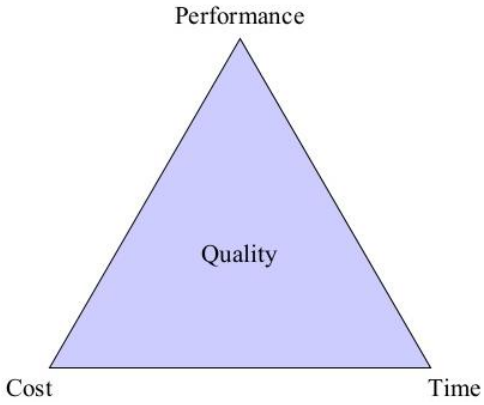


Figure 1: Time, Cost, and Performance Triangle

Having conferred the 3 parts, value is typically given high priority as guaranteeing the massive funding are incredibly tough. It is by specializing in the finance it permits to achieve momentum and move forward within the early stages of development to secure act of parliament [3]. However, that said, victimisation industrial incentives and drivers through the delivery of the rest of the programme will impact quality and final MEP providing to the artificial language.

MEP costs, complexness and emergence will be found later during a project as a result of acquisition choice and contract incentives. Whichever the case once contracts area unit let contractors and suppliers area unit the most beneficiary of such things, and not the delivery organization (DO) or so the artificial language. Therefore, MEP ought to be focus and driven through the programme from the beginning. It's been quoted that Whole Life Costs (WLC), standardization and commonality area unit moving up the agenda in mega projects and wish to be within the future [1]. To permit a top quality final MEP product the MEP style delivery ought to be thought of in its totality.

It has been observed that the civil fundamentals of enormous come equate to over the MEP Systems in terms of scale. This will be overwhelming and area unit considered initial, because the programme dictate, but they can't be considered within the same method as MEP. Civil parts don't have a similar criteria required for style and installation for the artificial language and don't want a similar frequency of operation and maintenance, as for MEP Systems. This can be this main reason they're therefore totally different and should be considered consistently for MEP style, acquisition and delivery strategy.

2. Objectives of Railway Operators

The bottom up look viewed in the MEP product offering in Figure 2, it has been observed that from the RO viewpoint it can summit to aspects that are not willingly contemplated about in the early stages of requirement planning, design as well as the procurement in the DO. It is highlighted in the figure that the main theme emulating through is commonality, standardization and quality for MEP design and procurement. These can critically help achieve the RO base objectives. When Infrastructure is handed over the RO needs to operate the systems, and the task of the DO is to provide a safe working environment for the RO to work [19].

When the infrastructures are designed and mounted in a way that repairs are tough to accomplish, assets are exists unmaintained precedent of their existence expectancy. Malfunction will be able to occur, plummeting performance of the Railway System. This type of circumstances should be circumventing as much as realistic for projects involved in novel design. Design too wants to comply with the Construction Design Management (CDM) regulations [4], wherever operations and

particularly maintenance and replacement is given a great deal of focus in the newest amendment of the regulations, from a design and delivery perspective. This puts more onerous on the DO to delivery such design.

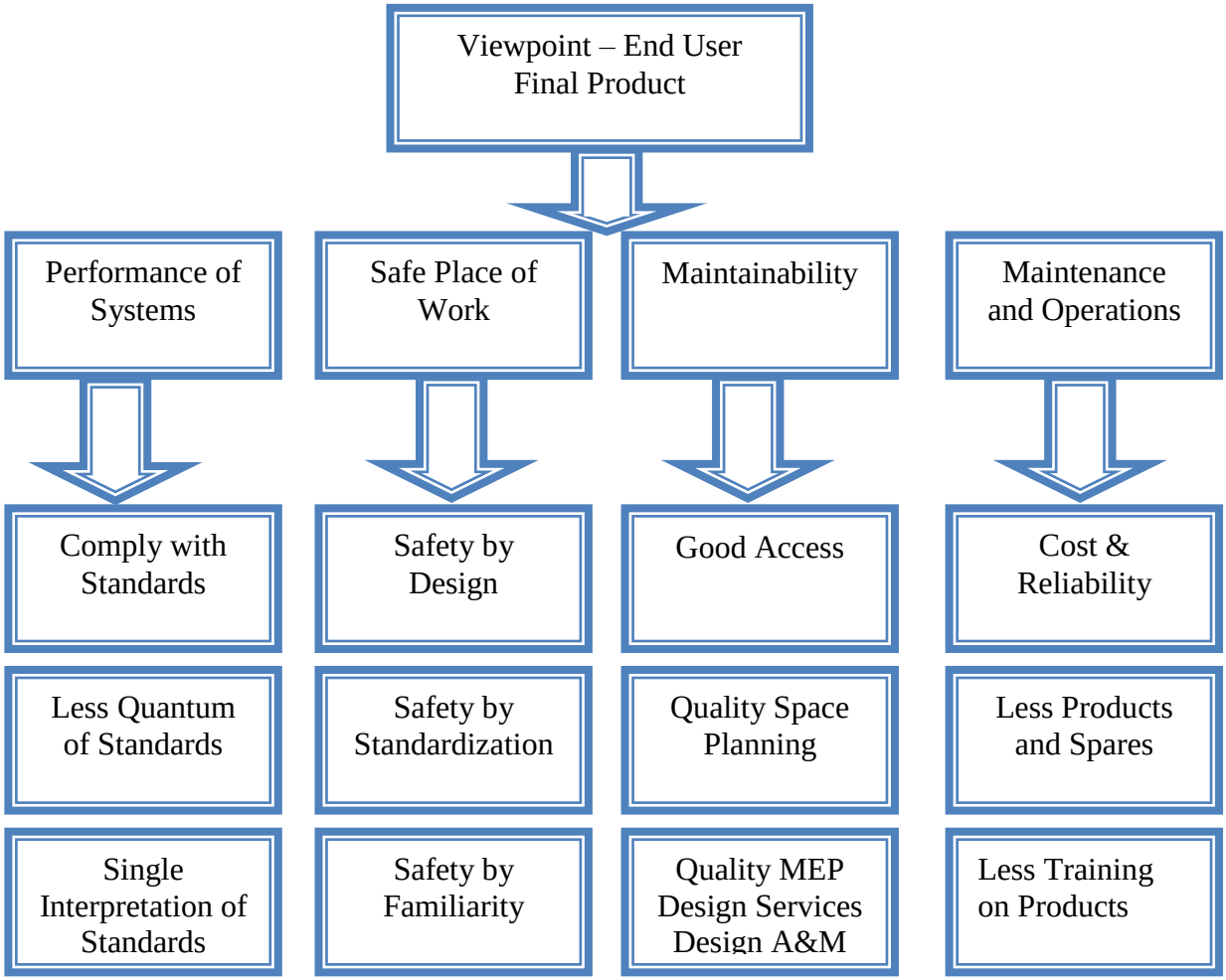


Figure 2: Infrastructure Manager Objectives and Route to Optimum Final MEP Product (Source: Jonathan K, ICE Publishing, 2017)

3. MEP Design Model in Railways

The most advantageous MEP design model on a project to afford high MEP excellence is debatably paramount placed with an SDO. This is placed in one location to administer and expand the design at least a RIBA F[1] / Grip 6 [5], preferably previous to the commitment of MEP fit out contracts. The SDO make up might be a mixture of different organizations, models as well formats, but have to be a particular group of Engineers whose objectives are similar.

When the construction contracts are allowed the manipulation of design alters and eminence is abridged. Designer's enticements and frame of mind are usually to release best class and endeavour to be mutual with clients. Nevertheless, a contractor's motivation is typically conflicting and the driver is to accomplish financial growth, thus curbing designers, in particular when the programme is deferred.

Consequently if a contractor slots amidst the designer and client this is questionably the less encouraging position for a client and designer, and as a result influence in the design part. Regrettably these days this is typically the case in the majority of contracts, however if there is a SDO then at least there will be an improved form of relationships to permit enhanced quality to surface. The uses of engaging a SDO model are shown in Fig. 3.

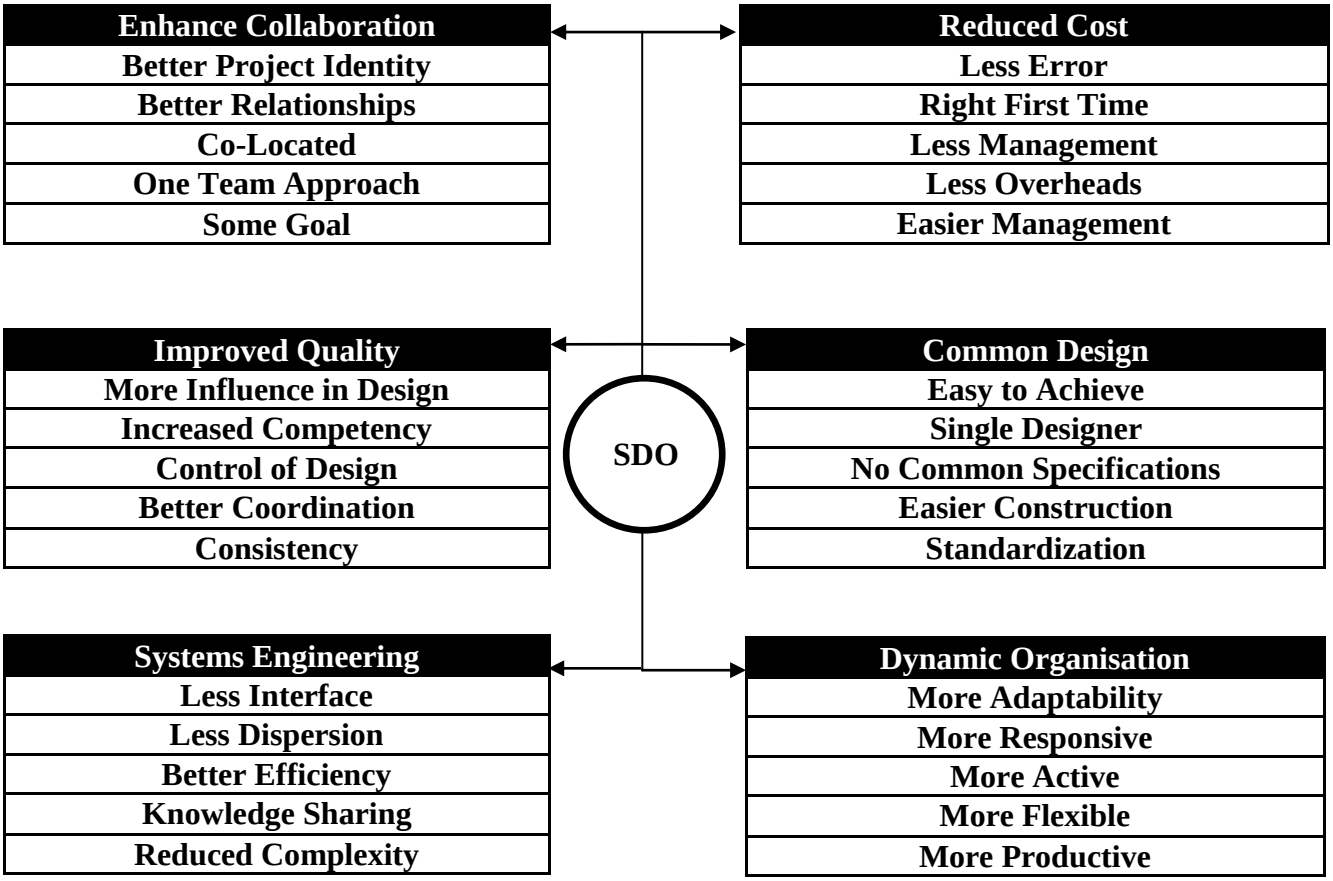


Figure 3: A Typical MEP Design Model with SDO (J. King 2017)

4. Common MEP Design

A widespread and a common design is obligatory on key subsurface projects for MEP systems to permit an improved finishing product to tender to the RO and to uphold and reinstate over the life cycle. It is furthermore better for WLC functions. Consistency of standards is a significant facet of MEP Engineering design and ought to be provided as much as realistic to permit a good deal of end product [9]. Common design is durable to permeate in the early parts of functional requirements, as its can be seen as a complicated prerequisite to devise effectively.

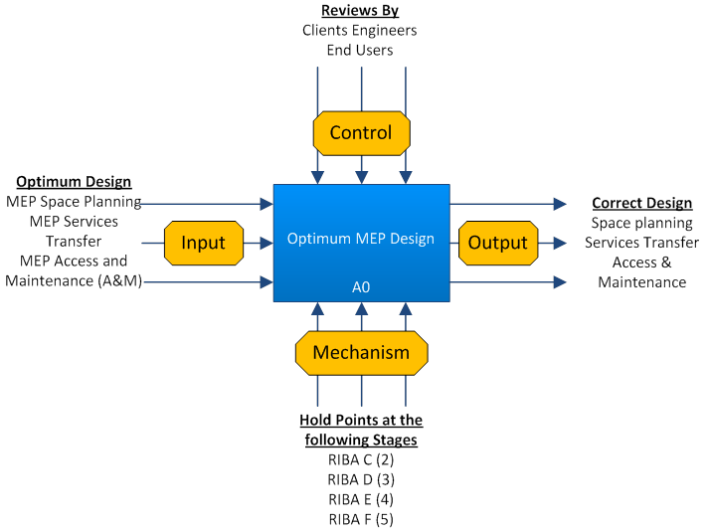


Figure 4: Sample IDEFO Diagram for MEP Common Design (Ref: Cross Rail Learning Legacy 2017)

It is also observed that offering a common set of principles and specifications will never guarantee a common design. It is understood that the multiple designers by their professional nature will assume and comprehend the requirements and specifications in their own unique way. It is nothing but the differences in the bodily connections of the brain are at the origin of what make people believe and perform in a different way from one another [10]. This is a methodical fact, and would be the alike for multiple design Engineers, when understanding necessities and principles on such projects.

The secured way to accomplish a common design is to offer an SDO. To ensure a complete common design in all respects without compromise is to use a single designer per discipline. This can be seen in Figure 4.

5. MEP Design in Railways (Prototyping Method)

The technique that can be endowed with is comparatively simple. It is by getting forward part of the programme such as an SSP. These are the major distinctive infrastructure items where various items arise that can be experienced in MEP design.

Undertake a design of a single location with Civil, Architecture, Structure and MEP along with Railway Systems Input where required. The other disciplines will be needed to allow the full integration and testing of design for the full complement of MEP services. The design be capable of being used as the genuine design when the precise site is essential to be offered in a contract. It can also be brought up to date if the time interval is very long before its completion. The process can be seen in Figure 5.

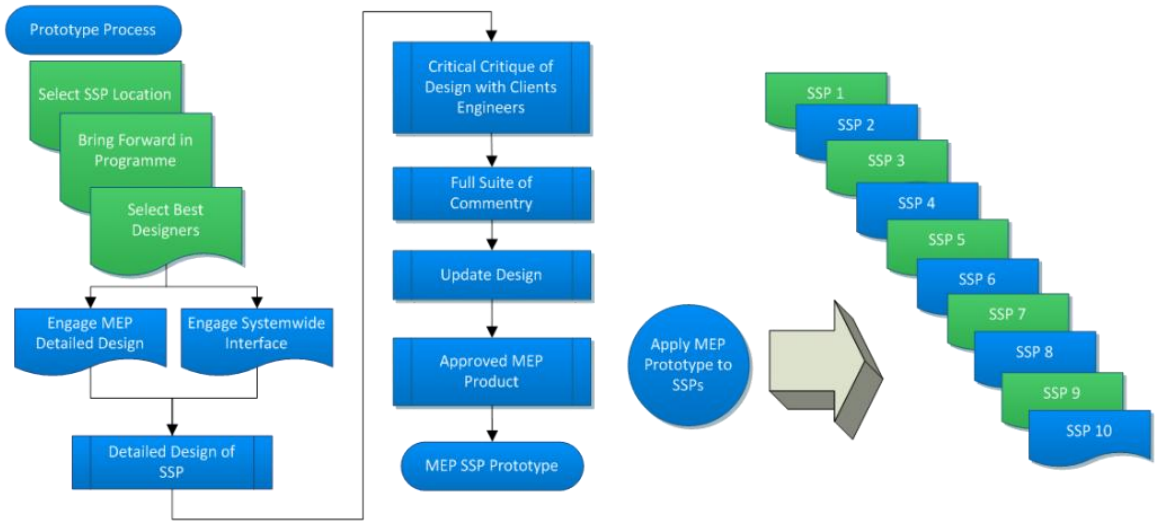


Figure 5: MEP Design Prototype Process (J. King, Cross Rail Ltd 2017)

With the design offered the finished design product will be tested with all the interfacing parties, Railway Systems, RO, Access and maintenance and Clients Engineering teams to test requirements. Systems Engineering EMC, RAMS can also be applied. From this test all the comments and reviews can be executed into the ultimate MEP design product at this location [7].

When the concluding product is designed and has attained quality, acquiescence and meets the requisite requirements it can be utilized as a archetype MEP design model at supplementary locations. This can then nearly replicate the product and fit as much as practical as a model. Designers make use of the design and craft fit to the latest location geometry. Apparently the diverse locations will have

dissimilar geometry and planning. Conversely these should be negligible and the design should be very comparable. The progression is quite notable and is additional in line with manufacturers and their products but fundamentally this is what an SSP is, a product. If a SSP can be analyzed as a product then the idea of design prototyping should be sturdily looked at in subsurface railway projects, where several sites of the similar product are endowed with.

6. MEP Guidance for Railways

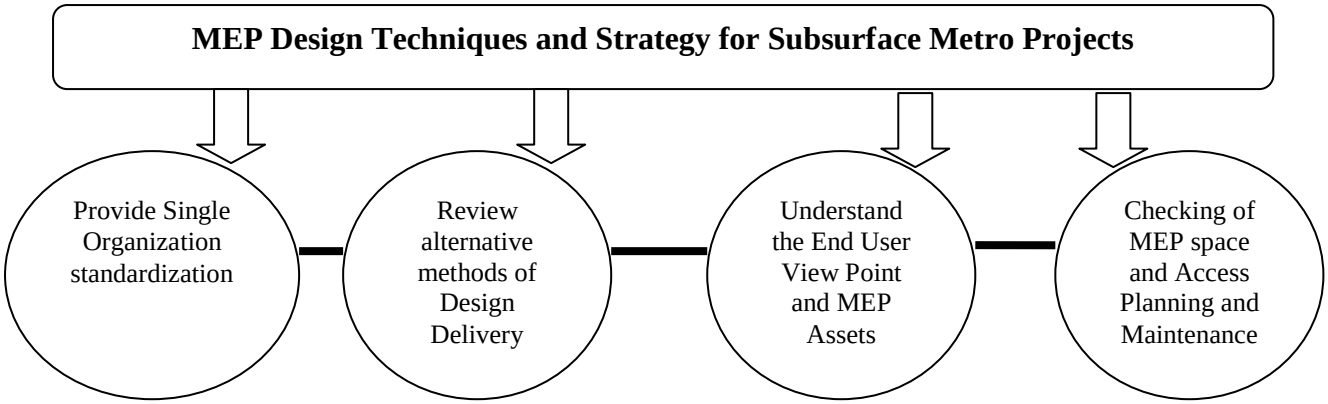
Guidance can be used from many sources. Experience and competence based on previous projects where successful implementation has been provided to the RO is probably key. This includes A&M that has been proven by maintaining plant safely. Typical guides in the market place used by designers are the following;

- BSRIA TN 15/2001 Rules of Thumb Assessing Building Services[12]
- BSRIA BG 9/2011 Rules of Thumb Guidelines for Building Services[13]
- BSRIA BG 55/2014 Safety in Building Services design[14]
- MOD Design & Maintenance Guide 08 Space requirements for plant access, operation and maintenance 08[15]
- CIBSE Maintenance engineering and management CIBSE Guide M[9]
- CIBSE Electricity in Buildings CIBSE Guide K [16]

The MOD guide is predominantly well comprehensive presenting many plant applications. This is now recited in the building regulations and is endorsed by CIBSE. Designers should already be using these and others to endeavor to provide a good quality design. These can be enforced to guide the designers to provide a suitable design offering.

7. Conclusions

To set best MEP design strategies in subsurface railway projects the DO is recommended to connect in preliminary review of how the MEP product will be lastly received by the RO. The ROs objectives are distinctive and are not focused on time or cost which is at the pinnacle of the agenda at early stages of major programmes [18]. The DO ought to take a look from an RO perspective as it can be fairly a different picture, and the depiction wants to be recognized when making conclusions on project procurement and MEP design strategy. MEP assets are enormously different to Civil and Structural assets in terms of A&M and process so they need to be out looked differently in terms of design approach and even more so in product range and design delivery[19]. Conventionally outsized Railway subsurface projects are led by Civil disciplines and mentality sets as foremost Civil decisions required to be made earlier in the programme. These conclusions can have serious MEP impacts to the project which can put hidden and until later in the project when MEP and Systems fit out has more hubs, which of course can be too late.



The SDO technique of design deliverance has a variety of advantages from all features of the project. This approach can be a hopeful design delivery route which can not only diminish cost but can greatly advance quality, and astoundingly, programme. Many benefits can be seen similar to that of an IPD approach which is known about in other industry. Collaboration being the most prominent alongside common design. Common design principles should be provided to allow standardization in design. This theme should be extending to the MEP component selection. This will suggest improved upholding policy and operations procedures and lastly WLC for the RO [17]. Different design strategy and templates should be investigated such as design prototyping. This process can also surmount the challenges of offering route to optimal MEP design. The notion is not simple to grasp, as it's not a build prototype but design only. However, it makes sense for design of multiple units of the same type. The foremost advantages are alike as standard advantages brought about by prototyping. Costs are very modest to modify one design, rather than 10s of numbers of designs late in the programme. Only by commissioning a complete design to a very comprehensive level where all design and crossing point related issues will be accurately tested and revealed.

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