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But there is another school of thought people like Nuno Jill who is pictured here who is a professor at the Manchester school of business Nuno was here actually about a year and a half ago he even taught a gyan course but I think you guys were probably very early on and I do not think any of you took that class, so he has a slightly different view he says look people analyze the information that they have, so initially at the start of the project it is essentially only the project promote who sort of says I want to build this airport or I want to build this railway or whatever they do not necessarily get down to doing a detailed design for it is detailed design is done later when you have decided you give it to an architect designer than they actually figure out how much reinforcement is designed etcetera.

So at this stage people tend to have you know more ballpark sort of figure, so they start going with per square foot this I generally what this kind of project cost, so I am developing an airport then I look at a few airport other airport and I sort of say per square feet this is roughly the cost my airport is sort of so big and therefore this is roughly the cost that is going to that I am going to have to sort of figure in my outlet but then what happens is as the project progresses more and more stakeholders with information start entering, so you actually have people who are doing the land acquisition will probably have a better idea on what the land is actually going to cost you actually have architects.

Who come in and say okay this is the kind of architectures and therefore the quantity of material that you might have had in mind probably a little bit less than what you want to have it you want to have an iconic building you have mechanical electrical engineers who are coming in and sort of saying for the kind of airport that you are building the air conditioning that you have to do the baggage handling system that you have to have they elect the energy requirements etcetera are probably going to be this.

So as more and more people come in you get more and more precise information about what that airport is going to need and how much it is going to cost and so essentially what nodal says is at the beginning because you did not have enough information you came out with a ballpark estimate and as you get more and more information you discover things that perhaps you did not anticipate earlier and those then tend to shoot up the cost.

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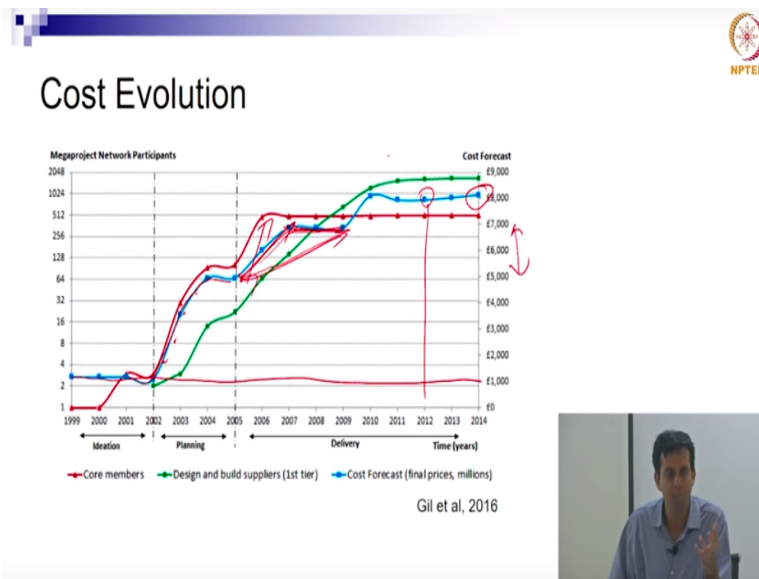
So one of the examples that you know he gives and I think this is there in one of the papers I am not sure is he is done a lot of analysis on a bunch of mega project in the US I think this was the London Olympics if I remember correctly, so let us just follow the blue line, so the blue line is the cost forecast like the London Olympics were in 2012 but London bid and won the Olympics the right to hosts the Olympics much-much earlier so I think was the late 90's or whatever when along with other cities they competed they set up they won the big right at the time when you win the bid right.

So one is you have to convince the international Olympic Committee that you are worthy of hosting the gains that a you will be able to host it seamlessly and be that it will add some value I mean you will bring in some unique touch that Madrid then Tokyo and you know whoever you were competing against would not be able to break, so that is one part but internally you also have to convince your treasury or your finance department or whatever because this is a country doing it is government essentially doing it that you have the money to do this.

So you have got to do both this is there is no point just showing a wonderful presentation to the international Olympic committee and then you come back and find that your country is not able to support it so you have got to so both so when they started off this is roughly what they thought it would cost so roughly they thought that this would cost about a billion pounds, so it is thousand this is the scale is it millions, so they thought it would cost a billion pounds but as things progressed look at what happens to the blue line the blue line keeps going up up up up right until finally.

When the Olympics were finished and there is always a little bit of post work which is why the time does not stop at 2012 although the Olympics finished at 2012 there is still sort of a little bit sort of cleanup etcetera you end at eight billion dollars which means your over run is how much like right percent it is eight times, so then he I saw he asked the question of why did these guys go from I mean I can I know you cannot estimate precisely if one billion went up to 1.2 billion, so fine you know these kinds of things happens but how can one billion go to eight billion I mean these numbers have like no relationship I mean treasure approval for one billion I can amend that approval for 1.2 million.

How to I approve I billion and end up spending 8 billion and essentially he talks about how throughout the process more and more stakeholders started coming in and you know the cost of this one sort of example of this when do you think about the cost of the Olympics what do you think about it if I asked you okay Chennai wants to host the Olympics at some points what is it going to cost what are the elements that you will try to cost stadium construction ok great what is accommodation games village etcetera what is right transportation.

Now for instance how what we are starting to get is the thinks outside the game that you need to sort of cost, so you have got transportation let us sort of what else marketing expenses very good

what else land for building the stadium let us say all of that comes in all the electricity you know to run everything, so it is not just the civil works it is all where the energy going to come from etcetera pollution control measure that is something to think about what else alright so these are all great really but I thinks you all also realize if we think through this and if we think through it long enough will I am sure we will get into this you have got to realize that when you build all these stadium etcetera-etcetera right.

It is not just a few thousand athletes who are going to come in you are going to get a few millions of few know tens of millions of people coming in to watch the games now then that rises questions of where are they going to stay I mean I can build a games village for you know a few athletes I mean India sends I do not know few hundred people the US probably send about 500 people I do not know what the numbers are but these are manageable number but what happens if a million people descend upon my city where are they going to stay some infrastructure needs to be built.

How are they going to get in from venue to venue this is not saying you know festival times is coming there will be 10 percent extra increase on the traffic you might see considerable amount of stress on your existing infrastructure system whether it is autos or ubers or buses or metro rails or whatever which means you actually have to start investing a considerable amount of money in upgrading say your metro, so in the UK the entire what they called the tube which is the underground train infrastructure needed to be upgraded for the Olympics.

So it was not just let me a few roads it was essentially saying I have got to completely upgrade my underground tunneling infrastructure because I do not have to run trains at higher frequency except so these are things that you may not intuitively think about when you think about Olympic games you might think about stadium and you might think about sports village and all of these other things but what happens is as more and more so experienced people will think about some of these but what exactly will be the cost of upgrading the tunneling and train infrastructure system very different for the Olympic authority to get a number I can talk to a few people.

I can get a ballpark but only when I start getting into details of how many do I need to build new stations do I need to expand do I need to buy new trains to it at a particular frequency will

actually come at the number, so these are the kinds of things that keep happening which raises this cost and essentially what happens is the cost keep going keeps going up and reason you find relatively flat portions here is that some points the treasury in the UK said look you guys are irritating you just constantly coming up and asking for more money you said one then you came up to sort of 1.5 to 2.53 I mean this is sort of never-ending.

So you know what I am going to do somewhere here I am just going to raise this whether you guys you might not have you might actually have projected something like this but I cannot just sort of meeting with you guys every month or every two months and just keep raising it by you know few hundred million dollar you know I am going to raise it by I do not know what this is 20 billion all right and therefore you use it for the future and therefore these guys came up.

So that is why you find a little bit of dip here because it is not as if they did not have a cost overrun here it is just that this increase was way steeper than what they had asked for and, so it actually covered this entire period and still kept going up as you can see then it sort of flattens out there a little bit, so Nuno's version is it is not optimism some bias it is not that I am overly optimistic, optimistic means I have data but I chose to pick the optimal mean the optimistic soul I am not purposefully deceptive I am just do not have the data in both optimism bias and purposeful deception.

I assume you have the data but you choose to believe one end of standard the distribution curve or you choose to purposefully look at a certain number here I am saying look I do not even have that distribution I do not know because more and more people are sort of coming in as the project progresses and that is sort of essentially the story of these mega project and you will find in many-many megaprojects for instance even if you take our own Chennai metro rail I remember an article in the newspaper when phase one was starting metro had initially decided to start from point A and end at point B.

And people who are a bit downstream from point B suddenly started lobbying and saying why you coming all the way to point B cannot you like go to point B plus delta because that would cover as well and because of the you know politically sensitive nature of that are etcetera I think a decision was made to go on to B plus delta so but again when then initial proclamation were made when the initial time estimate and cost estimates were put out you were only looking at

you know start to B start point A to point B later on you actually have you know new stakeholders coming in putting more demands on the project.

And in this case therefore the length and the time and the cost and all of that sort of increase now technically these come under cost overrun although there was a little bit of a change in scope etcetera so these are classic cases of people saying you know the you started at a point where you did not have complete information over a period of time you get more and more information the project balloons out yeah, so Olympics is very difficult to sort of say it because different Olympics are different the number of people landing up in the UK would have been fundamentally different that the number of people landing up in Brazil.

What it would take for Brazil to gear itself for the Olympics or Rio is little bit different from London because where they are starting with regards to infrastructure is fundamentally different, so Greece for instance the host of the Athens hosted the Olympics at some point there starting point in some ways is much lower than a city like Atlanta which by the way you know had Georgia tech University for instance hosted a number of the games and there was no real need to build stadium because that University had world-class you know facility.

So it is very difficult for me to learn from Olympic because they are also geographically dispersed number one and the all happen you know once in four year so you get one Olympic once in four year your data points are very minimal and again you have that tendency to be able to say oh I know this happened and we saw the Montreal case late we read about the Montreal Olympic case not very dissimilar things skyrocketed for a number of reasons which are similar to this but again you sort of go back and say poor planning, so it is a little bit of possibly of a mix of being a bit optimistic but also not having enough information at the start so this is this guy's explanation right perhaps in reality again this also makes some amount of sense.

Organizational Evolution

Gil et al, 2016
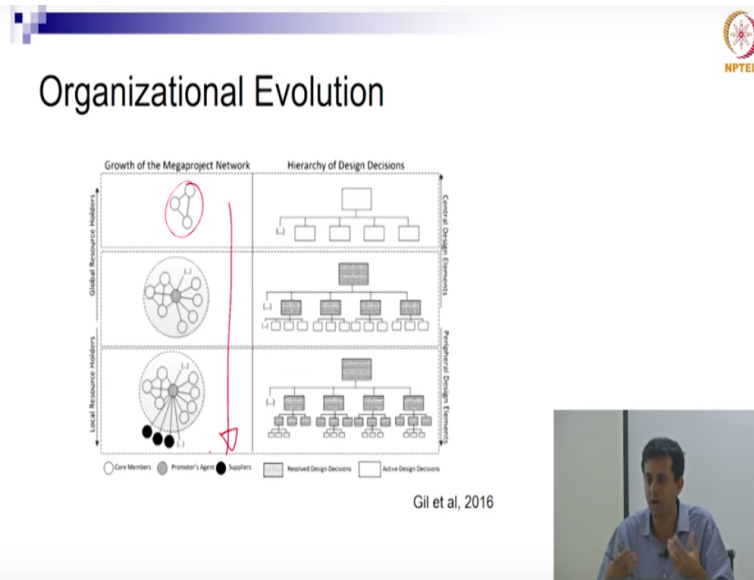
So perhaps in reality we have to blend both so this is sort of you know new Jill's idea is he says when you look at the project organization the number of organization are involved in looking at the project this is what happens over time right at the beginning you have a small core group of people that core groups starts becoming bigger and bigger and when we talk about a core group if we could talk about people who have a decision making role in the project so we are taking about a consulting who can actually come and make a decision change right who has the authority and the power to make a design change so that those kinds of people are part of the core group.

So the core group keeps evolving and at a certain point of time you have you know perhaps what he calls the periphery that starts to form which are a number of people who you would depend on for information but may not necessarily be able to change the project so some supplier might say this particular material you are using in short supply all supplied for you but you might have to pay a little bit more so these are people on the periphery of the project but your core network keeps increase.

And as the core network increases more issue come up with regards to the project so essentially the point is promoters are part of the central core that makes decision with actors on the periphery and the promoters are the one who controlled the sequence with which people come so for instance there is no harm in the Olympic development authority or the British Olympic Authority or whatever they are calling they call themselves bringing all these people together doing a detailed cost estimate right and you know actually working out how much the rail infrastructure needs to be you know strengthened etcetera.

How much this stadium need to be refurbished what hew stadium needs to be build who the architect is what that design is there is nothing stopping them from doing all of that work before going and presenting in front of the international Olympic committee to host the project to host the Olympic the reason you did not do that in this case is if you did all of that work and you were not awarded the Olympics it is waste of time, so there is nothing stopping us from getting all the information up in the beginning but it is a very time consuming process before you can actually start the project and because of a variety of reason because you want to start the project you start with a certain amount of information and then keep adding more people onto the network.

So the promoters then control who comes in number one and when do they come in, so when do we really bring in the NGO's who have social and environmental concerns in is a decision that promoters need to take you can have that meeting at the beginning of the project we can have

that meeting even before you start the project or you can have that meeting one year after the project it is up to you as a project developer to decide when to bring them in bringing them in early is good perhaps they can work with you as partners bringing them in early might also lead to a delay in when can actually count the start of the project and so you have to strategize that decision but the act of the matter is that if you ignore the right people at the right time it could be costly

So it is always it is sort of goldilocks kind of effect you do not want to bring in people too early because then they are sort of causing confusion you do not want to bring in people too late because then they are suggesting changes that are costing how do you bring in people at the right time, so this is one of the big challenge, so and this is sort of what he calls polycentric governance he says it is not that once person is making all the decision because no one person can understand how to build a metro rail network or how to build an Olympic stadium or an airport or any of these megaproject the expertise is vested in different people only the baggage handling guys really understand the baggage handling technology.

And how they can implement the baggage handling system in the kind of airport design and layout that you are giving them baggage handling is relatively complex thing as soon as your bags come off airplane many thing happen some of them need to go to the carousel for people to pick them up but some people are in transit which means the bags automatically need to go to wherever they are transiting to and you know people getting off a flight fifty percent of them are maybe going out into the city fifty percent are going elsewhere but each of them are going somewhere else right someone's landing in Chennai and going in Nagpur someone else is going to Indore someone else going to Mumbai.

So sorting all of these is not trivial, so your baggage tags you know are critical they need to be read they need to be sorted sometimes your connection is only half an hour, so you get off the flight and you bought the next flight but somehow your nags need to get off and make it to the right flight in time as well, so these are complex issues, so how much does it cost to put in baggage handling system and how does it work I do not know right LNT would not know right because they know the civil engineering part of it BA or you know one of these large international baggage handling system.

So when do I bring them is the question if I bring them in too early I risk compromising my architectures design for the baggage handling for what would be easier for baggage I bring them in too late not sure how that would work guys right, so therefore so the point is the whole governance cannot be done by one person that is polycentric in the sense means there are many centers there are many people who have decision that they make to govern these kinds of projects okay.

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So how do you manage how do you make projects finish on time and on budget one is think through how you would sequence when you would bring people in we have seen cases where NGO's are brought in very late in the process create a huge ruckus and that really adds on extra cost to these projects, so you have seen those costs another option is you just build in cost and times buffers you sort of do the opposite of purposeful deception you purposefully put in buffers you say okay you know I think you know it is going to take 12 months I am going to say 18 I think it is going to take this much and.

So that is the very difficult decision to make right very difficult to go to a finance department and say can you budget 10000 crores for this project I think it will only take 8000 but I want you ti budget 10000 that becomes difficult because these guys is saying money is scarce if you do not need the two thousand I will invest it in healthcare I will invest it in education there is, so many other places I can put it in why should I earmark it for you, so very difficult decision but given

the history of megaproject may be it is necessary right to put those buffers can I design it in such a way that you know even if a stakeholder comes in later they do not really have to change the design very much.

So this was the football stadium the football example that was being presented we know that the Olympic stadium the main track stadium is only going to be used for one week because even though the Olympic are 15 days the track events are only for one day after that do you need a dedicated track stadium there are not that many track event that happens that you need a dedicated tract stadium on the other hand as many of you will be familiar the UK is football is very-very popular in the UK possibly the most popular sport in the UK and you could convince you know a London based team such as Arsenal or somebody to take over the stadium everyone's looking at you know worldwide viewership is increasing people want bigger stadium fancier stadium.

So some of these football clubs are looking for different stadiums, so if would be great if you built the stadium but if the stadium was then very quickly bought over by say Arsenal or whatever or some other London based sort of club now the sort of that also saves you a lot of money but the point is an athletic stadium and a football stadium are a bit different right, so in an athletic stadium for instance there is a hundred meter set of track which is where a lot of people are really going to watch you do not so much care about you know people.

So that is sort of the prime easting but when you watch a football match you want to be able to get a good view irrespective of where you sit which means the way you design and column etcetera are a bit different, so the question is going back with what we talked about yesterday in terms of flexible design can we actually you know think though and build in design whether is arsenal or whether it is whether I give it out for some other purpose, so for instance in the US in American football there is a team in San Francisco 49ers.

So they play American Football now they are doing terribly I think they have one out of seven matches they have played this season or whatever but they just built a brand new stadium right sponsored by Levis the jeans some it is called the Levis stadium in fact they should no longer be called the San Francisco 49ers they should be the Santa Clara 49ers because the stadium is no

longer in San Francisco it is in Santa Clara they play eight games a year because the football season is 16 games 8 home 8 away each game is whatever right couple of hours.

So you are building an entire stadium for like 16 hours of action over a year or 25 hours of action over here how much sense does that make which means you have got to think about what you are going to do in with that stadium in the meantime, so what do they do rock concerts happen at that stadium you know the CEO of cisco right this large telecommunications company in the bay area's guy called John Chambers just stepped down a year or two ago his farewell was done in that stadium, so you have to therefore think of making the stadium multi-purpose.

So that as other stakeholders come in this case it was a football club trying to come in and buy or sort of use part of that stadium you design it in such a way that the stadium can be used later or that facility can be used it or whether the stake holder is that comes in you know finds a way to work with that sort of in piece of infrastructure, so can you future proof designs could be costly because you do not know whether that person will come in or not but maybe that is something that you do and also you have to you can get you can you have got to sort of figure out where do you draw the line where do I actually build something extra versus where do I not and there you probably need some sort of umpires or referees who can actually resolve that.

So essentially what Nuno Gill says is it is not about optimism bias it is but about the fact that you do not have data if you do not have data what you need to do you need to bring people with data in as early as possible at the right time you need to build in cost and time buffers because you know do not have the data you have got to sort of try to build design which do not need to be change later on because you have taken care of contingencies in the future and you have got to sort of bring in some kind of dispute resolution mechanism so that scope just does not keep getting add at all.

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Of course there risk and they were presented you get actors in too early you get important actors in too late all of these kinds of things and you might still get uncertainties that affect the project that you that all your buffers etcetera could never really meet.

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So an example Chennai metro rail phase one original cost was budgeted at fourteen thousand crores this phase one came in at roughly about nineteen thousand crores number of reasons including reasons relating to foreign exchange fluctuation and, so on right because some of the borrowing was from the Japanese etcetera but when you look at some of the reasons you find

that the land acquisition cost were higher than the land acquisition costs were a bit higher than planned, so again you budgeted something for land acquisition but when you started negotiating with people and you found out the actual guideline value were different from you know the market value and try to resolve all of this there was sort of an increase in cost.

Which you probably did not budget for again not was it optimism was it strategic misrepresentation planned purpose of deception or is just fact that you did not have enough data there were several scope changes right and I think I might have spoken about one of these earlier which I find very interesting there were several but one of the interesting ones was if you guys see the metro rail and going to the airport you will see that close to the airport if I told you guys this before, so observed next time you go to the airport you will see that the metro area is going above ground you will see that it suddenly dips underground very close to the airport but come back up above ground.

So when you get out at the airport you are still above ground at the same elevation, so you should be asking the question what is happening I mean you are going overhead why do not you just continue to go overhead why you sort of going loop the loop and so I call it the world cheapest rollercoaster, so for 50 rupees you can go up and nose literally 500 meters and the reason that happened was for a variety of reason metro rail decided we build this above ground it is cheaper and we have that large road we can put appears on that road we can build it above ground all of that was fine but as they were constructing.

So after all of these was approved after the funding was obtained after the designs were done after the constructions started the airport authority of India said they we have a problem we have you know an emergency runway rarely used or whatever but that is perpendicular to the main runways and it turns out that of an emergency landing has to happen on that runway something like this then if a metro rail is actually passing at more less the eye level of the pilot as he is landing then that might cause a distraction and therefore near that runway we cannot have the metro rail going.

So essentially they said look we cannot have the metro area and so in this there were sort of major argument there was this debates on what is the safe distance that will not tend to distract a pilot and you know some experts said the metro rail is already being built at that safe distance

and other said no-no you are not at that safe distance depends on the assumptions that we being used for that calculation, so finally the metro rail said look this is delaying the project too much, so I will bear some extra cost and I will go underground, so now remember this now cost as cost this no count as a cost overrun this is part of that 19000 crore.

But again it is possibly because a key stakeholder was involved a bit later in the process at the airport authority will roll much earlier and you have found this out earlier then worst case you could have but he is just budgeted into or you could have said that critical stretch because there is also the officer's training academy which is also somewhat sensitive etcetera let us just go underground in that stretch you budget, so you see that these kinds of explanation are starting to come through even when you look at the these kinds of projects all right so that is part one the second is the whole uncertainly by design let us see how much we have.

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INCOMPLETE BY DESIGN

A pragmatic approach to design in which incompleteness is harnessed in a generative manner

INTRODUCTION

- Completeness allows for the pre-specification of a problem, the identification of pre-existing alternatives and the choice of the most optimal solution
- In traditional settings, these two meanings of design have been separated from one another. One would engage in a process of design (the verb) so as to emerge with a design (the noun) for a specific context.
- In contemporary settings, however, designs are more appropriately viewed as being simultaneously noun and verb, with every outcome marking the beginning of a new process.

So I will be presenting on incompleteness but design, so what is the complete design actually it is a design in which all the problem are pre specified there is proper identification of existing alternative and we the choice of most optimum solution so there are two kind of approaches to a design first is the scientific approach and second is the pragmatic approach, so in traditional setting of design it comes under the scientific approach, so here the meaning of design is in terms of if we consider as a verb or if we consider as a noun both are different.

So if you consider it as a verb it is mainly the process to the design and in if we consider it as a noun it is what has emerged out of the process, so in case of contemporary setting which contains the pragmatic approach to the design this both meaning are simultaneously used, so in this process it gives new beginning to new process and it triggers actions.

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SCIENTIFIC DESIGN IN PRACTISE

- The form and function of a system must be clearly specified.
- Only with such a complete representation it is possible to identify clear and stable boundaries between self-contained components that mask much of the complexity.

So in scientific design in practice it has proper form and function of the system and it is clearly specified but and also it has all the self-contained components of the design have proper and clear boundaries.

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PRAGMATIC APPROACH TO DESIGN

- A scientific approach to design — one that requires complete representation of the problem and identifies the optimal solution — is based on the assumption that the environment is stable.
- However, such an approach is likely to run into problems in environments characterized by continual change

But in case of pragmatic approach to the design the boundaries of the different components is not very clear and it is sort of blurred in scientific approach the as the design require complete representation of problem and identifies the optimum solution there may be case that in case of

unstability in designing environment it may it may fail, so here are the case two cases of pragmatic approaches design first is the Linux and second one is the Wikipedia.

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So Linux is a operating system it was a hobby project of Linux Torvalds, so what he did was he wrote some programs to just see how the 386 processor they worked with the Minix operating system, so after doing this he just released the very basic version of Linux that is Linux zero one, so that itself tells that the design of that or operating system is not very complete and he designed this software as a opens of open source software, so he just release it and within a two months he was able to see that 30 people have contributed to the design the operating system and close to 200 reports of error and problem in Linux were detected.

So what happened after this the Linux was the subsequent version of Linux were release in even and odd version, so the odd version like those design it has some flaws or it has some design errors which needs to be corrected by the people who can access the software since it was open source software and the even version of the software was the complete, so it did not had any errors in the code built still at this point there were many possibilities of having some more changes in that.

So we can recount that due to the technological engagement and from different contributors the users and the consumers are the same people there is nothing like centralized a single person controlling all the source code and the related things, so and finally it was enabling the

developers to leave their footprint in the source code so it just involved a it was the involvement from the state in this case we can say the consumer and the designers.

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Second is the case of Wikipedia so Britannica is a encyclopedia it is designed to be a complete encyclopedia which involves a large group of experts and this follows a scientific approach but in case of Wikipedia it is again a open source platform where the founder of Wikipedia he thought that the knowledge of every individual may not be complete, so he just allows them to revise the facts that are present in the articles inside Wikipedia, so in this way we can see that ot promotes the generative engagement of the people and to promote the generating engagement they keep track of all the revisions and they might repost someone who is posting some irrelevant contain in the articles.

So coming to the discussions related to design participation within pragmatic approach the distinction between designer and user has blurred as I said before in case of scientific approach the distinction the boundaries were very clear and stable but in case of pragmatic approach the boundary is very blurred and it result in formation of community of co-designer who inscribed their own context into the emergent design and tolls such as Wiki GPL, GPL is general public license and the infrastructure provided by an internetwork with one another to facilitate participation and enable distributed development in case of pragmatic design approach.

It was considered that, it is considered that if there is some interruption they it will cause the design to failure but it will promote the change, so the author has described the case where there are two watchmakers so one out of them is making the watch with all the component individual components and if someone interrupts hit him while the designing of watch the whole design will the whole assembly of the components will just break and he would not be able to design the watch he has to reinitiate the designing of that watch but in case of the other watch maker the case is that he has a lot of components of the watch.

So he has divided it into the sub-divisions and he is assembling the individual the sub parts what he has, so in case of some interruption during the process of assembly the present part the sub-part which his assembling will just get disturbed, so he may not be redesigning it from the

scratch, so that is the so we said looked at a cost and time overruns you do not have good information.

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And then and therefore what do you do right and so we said bring in actors early makes sure you get information as much information upfront as you can good thinking build in some cost and time buffers obviously it is logical you do not know, so you need a little but of contingency good thinking you need a good group of you now referees to resolve disputes.

So you know costs do not keep escalating good thinking, so all of this helps to control and develop a successful project we also talk about you know flexible design we talked about how to build Olympic stadium, so the football clubs can use them we talked about flexibility in the last class as well but the question is how do we build flexible design.

So one of these ideas is coming from this entire community on generative design where if you look at Wikipedia which is a great example in the old days encyclopedia were like the encyclopedia Britannica just say you have a group of editors you have a group of writers we decide on what content goes in we put in that what content and then I give you an set of books which you have to buy if you buy those books whatever knowledge is there in those books is the knowledge that is available to you it cannot be automatically modified it can only be modified cannot be added to a set until you wait for me to bring my next edition which might be in six months in a year or etcetera.

And even that next edition may not have topics that are of interest to you so that is you know essentially what I call a complete design I have designed the encyclo-Britannica here this is what it is take it if you useful good if you do not find it useful do not buy it compare to Wikipedia right but there is no one person who is monitoring the content, so you and I can create a stub today I can create a stub you can add on to it we can continue to build more topics can come in new topic can come in so it is essentially when you say is Wikipedia are done what do you think does Wikipedia are done does not make sense to answer that question there is no much thing as Wikipedia being done it is out there people can continue to add on to it just like you know Linus.

It was not as if I gave you know in those days on a floppy disk an operating system and said install and this is it and you had the this open source you had the ability for people to continue to

add patches and functionality etcetera and just like with Wikipedia and with looks there is some kind of governance structure, so there could be incorrect facts that are added to Wikipedia there could be articles that are probably in poor taste and that are added into Wikipedia and therefore there are ways in which you know people or Bots trawl through these and you now remove pages and links and in Wikipedia particularly you have in brackets citation needed very often.
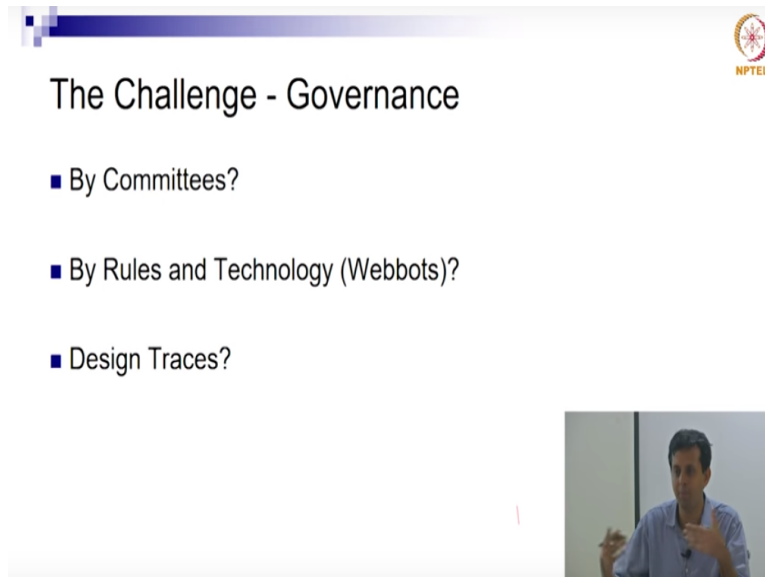
So very in this article saying look somebody's put thin in but it has not been corroborated, so you take it so there is some kind governance mechanism which we have to decide now the question is so essentially what does Wikipedia are done nobody developed I mean people developed a platform on which information is continually being added, so if you say who is responsible for the content and Wikipedia several thousands of people or several millions of people I do not know right so and people and therefore the content evolves right, so the younger generation today based on what they would like there are new pages that sort of evolve when new ways in which that is written even the language with which things are written can change right because different people might write it differently.

So this is essentially what we called incomplete evolutionary design I have designed something that can stand the test of time future generation can come in they can put in all kinds of articles that past generation may not have been interested in they might write it in a way in which past generation might not have been might not have written it they might interact, so therefore o have created something that is flexible then as new stakeholders come in they can continue to use okay now the question is can we take these ideas an apply them into infrastructure can I build infrastructure project also with the possibility of users being able to build on and redefine them going future it is almost the analogy of saying I will give a shell of the house and I will give you enough sort of you know grooves on the wall etcetera.

That you can put your walls whichever way you want coming in later because I am building the house upfront you are using house later may be you are you buying the house and renting it out to a third party how for instance do I design this, so that each of you can coming in and continue to reconfigure the house without having to do massive structural damage and you know knock off load bearing walls and column which is effectively not possible if I could do that then we could continue to pace with you know future generations we could continue to build

infrastructure where you will not have a huge redesign cost or you will not have huge added scope cost because you are needing to do a design in the future.

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So that essentially is the so the challenge of course is governance how do you sort of in the Wikipedia example or in the incomplete design example how do you decide what to go and what could but the open question and I do not thing infrastructure we have an answer but the open question is many projects run into problem because the future set that built into the project you know there are too many every new stakeholder comes in and they want as existing a new future put into the project and that sort of just becomes very-very costly and if I do not put in enough features into the projects then five years down the line ten years down the line I have a bunch of uses who do not find this useful.

So is there a way I can sort of create the Wikipedia kind of infrastructure where people can continue to sort of developed evolve on it and as a result of it as a new stakeholders comes in and says this is what I want this is sort of say sure right here is a space that sort of been earmarked and you can reconfigure and use for your purposes so there in no extra cost that has added on to it, so example I cannot remember who was who did I have the discussion with in my room yesterday on the parking garage I think it was Laxmikant or Harsh did you come somebody came in and we had this discussion on the parking garage you know remember we talked about three story parking garage if demand come up build six storeys.

So somebody I think it was Laxmikant came in and said another way of looking at flexibility is you build in six storeys but if the parking demand does not pickup you convert those other stories to some other purpose what that means we left for instance you want to convert it into residential or into commercial or whatever you will then have to look at all other kinds of fire safety water wastewater etcetera, so you can have configurable options but how do I you know come up with a design that allows for you know that is sort of incomplete to start with and allows for new stakeholders to come in and say ok now let me put this in this what it is going to cost and you would essentially say look we have got most of that worked out in the preliminary design.

All you have to do sort of ideas that we will have to think about with regard to infrastructure because otherwise there is too many stakeholders to a project and they all often have conflicting you know demands and if you start catering to peoples demands then you know cost just balloon out of the window if you do not cater to people's demands then people could so I will stop the project or stall the progress of the project, so you want a mechanism by which you sort of find this middle ground and perhaps design for incompleteness or incomplete design offers a philosophical approach, how you would do it on infrastructure and I am not 100 percent clear how I would implement this on an airport but it is something to sort of think about.

So these are all starting from social network analysis to incomplete design these are a bunch of ideas that if you think about carefully you can probably you know design projects that can avoid the fate of Dabol or of charge camera or over whatever a Montreal picks or whatever you have it might and I think that is essentially what we want to think about, so you can in fact itemize what we have talked about over the last ten or twelve classes they say here are a set of approaches right we have can we use all of them at the same time may be not but at least four different projects different approaches might help you design the project in a manner that it is much more useful eight and we are going to try to then use these case studies coming up to see which of these concepts could be applicable.

So the ideas when you present these cases you tell us all these cases run into problem, so we talk about the problem but then we start talking about what strategies could we have used that we have talked about in the last ten sessions or so that would actually be useful with regards to providing better approaches, so I will stop here for today.