Lecture 9

And, uh, so today we're going to talk about, uh, GDP, gross domestic product and government spending. Okay. And so, um, I was actually chatting with some of you and uh, obviously when we introduce a topic like GDP and government spending, people are like, yeah, wow. Uh, that's going to be exciting, right? And so I thought it's important to just give a little bit of context. And I won't make this more exciting necessarily, but the reasons that we, uh, cover the material that we've been doing the last, say, two weeks, uh, is all to, uh, create kind of a foundation for these big projects that you'll be doing. Okay. And so, um, sometimes when we deliver the content, uh, it it can be hard to apply kind of in the abstract. And so we have tried to use some examples, show some things from prior years. Uh, but all of this is intended to give you just kind of a starting point from which you can attack these projects. Okay. And so we do get that, you know, it is not necessarily as good as like the nearest or the most recent like Netflix release or something. Okay. Uh, but we're going to try to put just as much energy into it as we can. So thanks for coming along for that. Uh, so this is the agenda for today. And as you know, I was actually I, uh, sat in on my colleague racist talk on, uh, Tuesday. And I noticed he actually goes through this and you'll know that I don't. I just say, okay, here's what we're doing. It's on canvas if you want to take a look. Uh, but so these are the major bits. And basically what we're doing is building on what Reza introduced on Tuesday where he, he first introduced his term GDP, but he talked about the what we call the societal considerations to think about what else matters. And so what we're going to do today is to drill down a bit on this GDP, understand what it is and, uh, what's kind of where it comes from. Okay. So remember, uh, we've been talking about this when we talk about innovation at the systems level, problem solving at the systems level. And so when we look at the systems of our society, those include things like our economy. And, you know, in some ways we we would sort of take unless you are like a full on economist, you would kind of take the economy almost like as a given. Okay. Like you wake up in the morning, you buy a coffee, uh, you come to class, you pay your fees, maybe have a job, maybe get a study link payment. All of those bits are part of the economy, uh, which will have developed in New Zealand or any other country over a very long period of time. You know, there's certain, uh, traditions and, um, kind of, uh, conventions around our economy and in fact, the global economy. And so that's one of the systems that we operate within. And what we talked about. And if you read the material in, uh, the Meadows book, uh, it talks about, um, systems thinking, really looking at a system of systems. And so that's really what we do when we consider a systems level challenge is we're looking at a system of systems. And one of those systems is the economy. Okay. Another one is society itself. Okay. Uh, the ways in which we, um, function as a, as a society, as a group, uh, the responsibilities we have to each other. Actually, I have a colleague who's been in New Zealand about nine years, but, um, Sean's Australian and he's at a conference in San Francisco. Never been there. And he, uh, sent me a text. He says, mate, the homelessness here is out of control. And to me, that was just like, yeah, wow, dude, that's what San Francisco looks like these days. But to him, compared to society in New Zealand, that was confronting. Okay. And so all of these rules and of course, uh, these things are constantly changing. But all of the rules, all of the experiences that we have, uh, in society as a New Zealander, uh, will be things that you kind of get used to. Okay. And then, of course, the the other aspect of this is, um, the physical environment. And in New Zealand, of course, we're very lucky to have an incredibly beautiful, uh, an incredibly diverse, um, physical environment in which to live our lives and go for tramps and, um, go camping and go skiing in the South Island, things like that. Uh, and, and obviously that's something else that as New Zealanders, we would kind

of take for granted. And so all of these systems are sort of the backdrop against which we consider these big challenges. And, and we have to consider, uh, what could we change? What can we not change? Um, what are we sort of up, up against? Uh, one of the things that we, uh, talked about in a previous lecture is this, uh, what we. Call the, um, tension between kind of the old way and, uh, the new way. Uh, and we call that, um, fragmenting forces. So it's like, okay, here's how we used to do it. We move forward, turns out actually gets pulled back a little bit. And so that's what we're forced to deal with whenever we're looking at making big change. And, uh, this is, you know, we talk about these what we call the causal loop diagrams. And, uh, this is one in terms of how some of these systems interrelate. Okay. So Risa introduced this term, but basically gross domestic product or GDP is about everything that happens in that economy. And so the value of we say all goods and services. But you know, everything that you do in a day, everything that the government does in a day will be are included in gross domestic product. And in New Zealand, % of our GDP actually comes from the government. So the government of New Zealand, in terms of them, uh, building roads, uh building the city rail link, uh, providing study link payments, all that sort of stuff represents % of the whole economy. And that's actually puts New Zealand, uh, about in the middle of the so-called OECD countries. Okay. Uh, some the US is actually a little bit higher by %. Uh, and, and then some other countries are a little bit lower, I think Australia is just a little bit lower. So, uh, % of this whole thing comes from the government itself. And so, uh, we look at, we say the final goods. So if someone manufactures something that then gets put into something else. So let's say someone's actually building software and that gets actually, um, put into an embedded system. And uh, that actually comes out as a gaming platform. Let's say all of those things will be in that final, uh, value. Okay. Uh, and in most, most economies in the world, pretty much all, uh, use this GDP thing. And so, uh, raise it, uh, introduce this. And this is a formula in terms of what's called the expenditure approach. Okay. Consumption stuff. We buy like, you know, this water bottle, my phone subscription, uh, petrol for my car, I do, I do have a petrol car. I, I, I did kind of go through the, uh, the, uh, comparison when I bought my car a few years ago of, of, uh, electric car. But I do have a petrol car, so, so all that stuff, uh, goes into consumption. Okay. And then investment is if, uh, uh, business is buying things like a new factory, if they're buying, uh, heavy equipment in order to build a road, if, um, say, someone like, put it in Hogan, uh, which is doing massive infrastructure projects, uh, all of the equipment that they buy to complete those projects, that's going to be an investment. Okay. And then the final bit is this % I'm mentioning that is the government's, uh, expenditures themselves. So all that stuff together, plus exports minus imports. So, uh, we're selling lamb, for instance, uh, to, uh, Japan and the United States. And so, uh, that counts in our exports. But, uh, the car drivers, uh, Sbarro. Okay. So that's imported from Japan. And so we have to take everything that we're selling to other countries and minus out the stuff that we bring to New Zealand. And you will be aware that in New Zealand we bring quite a lot in, because turns out we're two islands kind of in the middle of nowhere. Right. And so we need to actually import quite a lot of stuff from around the world. So all of that goes into that formula to be able to measure that economy. And uh, this has been done for a very long time, nearly years. Uh, we're going to run the short clip. Uh, I'm, I'm actually, uh, working with a colleague, a young colleague that, um, I'm kind of helping him learn how to teach. And, uh, he says, do you always use a video? And I said, yep. Mario, I pretty much always do. It's just kind of a good break for the students from my own voice. So, uh, this is a short one, but we're gonna roll this. How do you measure the size of an entire economy? Let's say I buy a coffee here in London for £. Those £ are factored into the United Kingdom's GDP. And so is

this barista salary and this espresso machine. In fact, most of what's around you is part of GDP. GDP is an important gauge of the overall health of an economy. It stands for gross Domestic Product. Simply put, GDP measures the total value of all goods and services in a country. That means it measures a lot of stuff worth a lot of money. Here in the UK, GDP is around $. trillion per year. In the United States, the world's biggest economy. It's around $ trillion every year. How do you get to these numbers? Well, you can calculate GDP in a few different ways, but the most commonly used equation goes like this. Consumption plus investment plus government spending plus net exports equals GDP. Let's break that down. Consumption is another way of saying consumer spending. It's the money you or I spend on physical goods like coffee and on services like a haircut. In many developed economies, like the UK or the US, consumer spending makes up more than half of a country's GDP. The second part of the GDP equation is investment. This measures how much businesses spend on things like buildings, land and equipment. It also includes a major consumer investment. Buying a home investment can take a hit when the economy is suffering. You can see in this chart domestic business investment plummeted in the US during the financial crisis. That's because companies were trying to save money instead of putting it towards things like factories, machinery and equipment. Okay, now we get to government spending. This is the money local, state and national governments spend on things like roads, schools and defence. Government spending varies a lot depending on each country's approach to public goods and services. Take, for example, France, where government spending amounts to roughly % of GDP. That's compared to % in the UK and % in the US. That brings us to the final part of the GDP calculation. Net exports or exports minus imports. A lot of countries have negative net exports, meaning they bring in more products than they send out. For example, the UK imports around $ billion worth of coffee every year, but only exports around million, meaning its net exports of coffee are negative. Countries around the world collect data on consumption, investment, government spending and net exports. This makes GDP a universal measurement and a way for countries to stack up against one another. But it's not just the sum of the equation people look at. You'll often hear about the GDP growth rate or the percentage change in GDP over time. Generally, if an economy is healthy, GDP growth expands if an economy is in bad shape. GDP growth contracts two consecutive quarters of negative GDP growth are referred to as a recession. But GDP doesn't always give a full picture of the economy. Critics say the equation puts too much weight on production and manufacturing and not enough on services and the digital economy. Just think of Spotify for $ a month. You can listen to unlimited music from a huge range of artists. In the past, you'd have had to buy all of those albums separately, with each one contributing to GDP. It's hard to factor a digital service like Spotify into the GDP equation, which is used to measuring physical goods. GDP also doesn't measure economic equality and well-being. So even if a country is really rich according to GDP, wealth may be spread unevenly. Plus, GDP excludes unpaid work like volunteering for charity or child care, and it doesn't factor in costs like pollution or illegal activity. Some experts have come up with alternative measures GDP, that measure overall happiness and quality of life. But so far none of these have stuck. Maybe it's just too hard to put an economic value on that first sip of Morning Joe. Hey, everyone. Elizabeth here. Okay. Uh, so that, you know, obviously we've we've hit that a couple different times, a couple different ways, but, uh, just wanting to kind of make sure that we. Sorry. And there is. Must be. One of our old lectures is on that drive. Okay. So, uh, just just for, uh, kind of completeness. There's two other ways to look at this. And that is what they called the production approach. And that is where you actually, uh, do the value add. So in other words, if we did buy in some software that was going to be part of a gaming

platform, uh, we would only measure the amount that we add in terms of value. So, uh, the software company, uh, is going to, um, contribute the information about the software itself. And then we're going to do the what's called the value added approach of the things that we do before we sell it on to other next, whether that's a consumer or another company. Can the income approach is we actually look at all the incomes generated by different production approaches. Uh, and so, uh, that's going to be we look at everyone's, uh, wages, we look at profits and we look at rental income. So any of these will get you. So theoretically these all you get you to the same answer. Okay. So the economists geek out on this. But basically all of this is just different ways of coming to the same outcome okay. And so when when they look at it and she talks in the video about different countries GDPs and some very large ones. But one of the ways that we actually, uh, look at this is, uh, on a per capita basis, because then we can actually obviously compare between different countries. And so, for instance, if we look at this, uh, for this for last year in New Zealand is around, uh, $,, uh, US dollars per, per person, uh, whereas Australia is about ,. Okay. And again, the average for all OECD countries, about ,. So we're just a bit above the average. And so it's just one way of looking at what are we doing versus other countries. Now again, this is one of those things that, um, has some limitations in terms of what you do with it, because you could say, oh, actually, we're not as cool as Australia, for instance. Okay. Well, just because this number is higher in Australia doesn't mean that they're necessarily doing things better there. And of course, you know, the, the um, tension that exists, particularly right now of people moving to Australia is, oh, well, I have a better life. Okay. Depends a lot on how you measure a better life. Is that about how much money you earn? Is that about, uh, the ability for your children to visit their nan? Is that about the ability to easily get to a ski slope? What what ultimately matters in terms of of the life that you want to live? Okay. And so that's considered one of the limitations of using this GDP. Okay. A few other things to note about this is and some of these are kind of intuitive, but just you know, this does come from uh, research. Is that so population has an inverse relationship with the GDP per capita. Easy maths okay. Basically the more people you have uh, the lower that goes down. But it does mean that, uh, so for instance, the, the, uh, uh, takeaway from this would be that higher levels of immigration to New Zealand are going to put downward pressure on GDP, other things being equal. Okay. Transparency score also has a positive correlation. New Zealand has quite a high transparency score. And so the more transparent an economy. In other words uh, how much uh the government makes information available. Uh, lack of corruption, things like that caused this to go up. Compulsory education year has a positive correlation with GDP per capita. Again, this one's kind of intuitive. Uh, basically, the more educated, the more clever our population is, uh, the more stuff they can produce. Whether that is, um, AI, whether that is, um, uh, farming, whether that is some kind of new manufacturing. Good. Uh, that's, that's in some ways intuitive. And you can kind of see here where various countries fall in in this process. Okay. And so then the other thing that we want to take a look at is what's called purchasing power parity. So those numbers we've been looking at GDP per capita. Those are just straight up uh maths numbers okay. And so it doesn't take into account the cost of living in a particular country. So if we look at purchasing power parity it does take into account cost of living. And so then we want to look at uh, how does our economy or how does a person's uh GDP contribution compare if you take into account differences in prices. And this may be particularly relevant in New Zealand because life is expensive. Okay. So if we look at this on a, on a purchasing power parity basis, uh, and then we can kind of see which are some. And if you look at New Zealand this is data. Uh purchasing power parity basis. We're at only ,. Okay. And so um, we were at I think the prior

number was around . And so on a purchasing power parity basis. And even though it's expensive here, if you go to places like Switzerland, Denmark, uh, Sweden. Okay, they're even more expensive than here. Uh, whereas if you look at, uh, countries, I don't think China is on this chart, but, uh, if you look at countries that are so-called emerging economies, uh, there's might be lower. And so we can actually look at this in the context of the whole world economy. And if we make adjustments for that purchasing power parity. Uh, the Chinese economy. Adjusted for cost of living, has a higher GDP than the United States. Okay. And so straight up, uh, cost of living in China is lower. I mean, it's gone up significantly over the past decade. It's lower. And so therefore, uh, the the total economy is, is bigger than the United States. Now, of course, also roughly four times the population. So, uh, that that's also a factor. But you can just kind of look at these things. And this is actually goes back to . That's the most recent. This uh, diagram was developed. Uh, but it just gives you ways of looking at the economy. So if we actually put these side by side so we can look at it on a purchasing power parity basis or straight up dollars. And so if we look at straight up dollars, obviously the Chinese economy then is quite a bit smaller than the US economy. Again recognising that the population is quite a lot larger. Uh, and, and actually, um, New Zealand unfortunately is so small we don't make it on this chart, but uh, Australia represents one point, about .% of the global economy. Okay, so if we look at what New Zealand's, um, per capita GDP has been historically and where it's projected to go in future. Uh, so there was a dip in and then, uh, a significant rise. Okay. And so basically, after a period of time where things in New Zealand were beginning to decline, uh, it took off again. Now, uh, what happened in about that time period? Yeah. Okay. And so what happened was the New Zealand government, like all governments, most governments in the world borrowed money in order to sort of keep things going. So they borrowed that money, uh, that came back to the economy in terms of things like, um, uh, payments for people to actually remain in their jobs. Uh, I forget what they called these payments. They actually gave payments to businesses in order to keep their staff employed. Uh, and, and the government was effectively paying for part of their ability to do that. Okay. And the rationale for that was, uh, once things hit up again, they'd have that staff they could pick right back up. And so that actually did allow for a much more the transition out of Covid. Uh, but as that money came into the economy, uh, people bought a lot of stuff. Okay. And so that that meant, uh, the more people are buying, uh, then the more uh, basically the more times that money goes through the economic system. And so as that happens, it causes this number to go up. Okay. So then we we kind of came out of Covid pretty good. And and the trajectory of this out of Covid is actually, uh, pretty impressive in global terms okay. Now that's projected to continue to go up in the next couple of years. However, uh, a couple of things have happened. Uh, the, uh, the inflation rate has been pretty significant in New Zealand in the last couple of years. And so remember, these aren't adjusted for inflation. So as the GDP goes up, if it goes up by a percentage that's lower than inflation, then in real what they call real terms it's actually going down. And so uh that's actually what's happening at the moment. And in that video she talked about uh recession. So the economists uh, at two quarters of negative GDP growth, uh, is classified as a recession. And we're in one of those now. Okay. And so, uh, and, you know, I don't have to tell you this. You buy groceries at countdown or the Woolworths or whatever they call themselves these days. Uh, and, and so life in New Zealand has gotten, uh, quite expensive for quite a lot of people. And, uh, so a lot of businesses, a lot of, uh, people are doing it tough and really, uh, trying to navigate what is today, uh, for, for many people, a challenging economy. Okay. So, uh, so, so basically that is a measure of the dollars and cents going through New Zealand's economy

and the, the some of the reasons why this will be important two year project is, uh, GDP is what drives the amount of tax that the government generates in New Zealand. And we'll look at those numbers in a minute. But, uh, the more GDP goes up, the more money there is for the government to tax. And the more that the government generates in tax, the more they have to spend on things like the health care system, that education system, uh, um, various environmental projects, uh, meeting climate change objectives, things like that. Okay. So the other thing that we talk about are what some people refer to as productivity. So productivity is about, uh, for each hour of work how much is generated back into the economy. Okay. And here again, uh, so the OECD average $ an hour. So, uh, for every hour somebody works. So whether that is a barista or a, um, high powered entertainment lawyer, uh, that that is the average of the output of their work. Okay. Now, obviously, uh, the barista is not making . Uh, well, in, in New Zealand, dollars, $ an hour. Okay. Uh, so this is an average across the whole economy, and it's not what someone earns. It's what they produce. Okay. So it's if you're working for an organisation and you're doing a heap of work, and, uh, one of the best examples of this is, um, these the so-called big four consultancy firms, KPMG and Deloitte and those sorts of things. Okay. Uh, and, you know, some of you will go to work for those organisations. We have a lot of engineering students who do that. Some of you probably work for them now or have had internships, but, um, so, so they might be paying you, I don't know, $ an hour or $ an hour or something like that. Uh, but they might be billing a client for your work, something like or or $ an hour. Okay. Now, what happens is they take your work and then, like, some partner person reviews it and says, uh, I think we should change that number and that paragraph and okay, like, okay, we'll send that off. And that partner person is making way more money. Okay. So that's actually been added in to what's being produced. But so when we look at these numbers, the key thing to remember is it's not how much someone's being paid. It's the amount they're actually generating for the economy. Okay. The other thing interesting about this is the average number of hours worked. Average Kiwi worked hours a week. Uh, and you know, obviously many of you do way more than that, but that's the average. And so all of this figures into, uh, what we can expect and what we can get done in terms of any government project that we're looking at. And so when we think about things like, uh, investing in new road infrastructure or particularly around things in terms of remediating, uh, the um, temperature gain, uh, related to climate emissions, those sorts of things. Okay. And any of the those investments have to be balanced against how much we actually produce and how much the government actually has to spend on these sorts of things. Okay. Uh, the interesting thing is that the current, uh, government, actually, we used to have this thing called the Productivity Commission in New Zealand have been around for a very long time, and the current government actually, um, disbanded that about three months ago. So in New Zealand, uh, there is no such thing anymore called the Productivity Commission. And, and so some people think this is a way that, that New Zealand is behind on this. And we should be looking at uh, like what do they do in places like Scandinavia where they have very, very high, uh, per capita GDP? And that comes down to things like, uh, in that part of the world. There's a lot of pharmaceutical companies. Pharmaceutical companies have very high what they call operating margins, basically. Um, they make a lot of money creating new drugs, okay. Because those are sold around the world to treat diseases. Turns out if you're sick, you'll pay a lot of money to feel better. So it's it's the balance between the sorts of activities New Zealand has and those that exist in other parts of the world. Okay. Uh, this has been used a very long time. Uh, razor talked about on Tuesday, uh, whether or not it needs to change and some of the other things that we can measure and, uh, all these other things

play into it as well. And so we just talk about this improved productivity, which may or may not be where our focus should be and and where your own focus, uh, might need to be or not be in terms of the projects you undertake, can an interesting thing is that so that's that's in terms of, uh, the production, what people actually creating with their work. And it's about, um, uh, how much people are actually being paid and how much they're working. But if we look at New Zealand's wealth per capita now, these numbers are per adult in New Zealand. So this isn't all the bodies. This is the adult bodies. So interestingly, New Zealand in the most recent year we have the data. Uh. New Zealand's, um, what's they say? Mean wealth per adult. Okay is the sixth highest in the world. And, uh, so that's around, uh, close to $,. And that's actually way down from the year before. Now, the biggest reason for that is one of the significant inputs to this number is, uh, wealth from properties. Okay. And so property prices actually went down over that period of time. And so these numbers went down. Okay. And one of the reasons that New Zealand will have gone up significantly over the past years is the property prices have gone up significantly in that time. And then, uh, that's been if we look at it on a median basis and you will remember your statistics classes, okay. Difference between means and medians. But, uh, New Zealand is actually the fourth highest in the world. Interesting. Australia the second highest, if we look at it on a median basis. And and so one of the questions that often comes up is should we actually tax wealth in New Zealand. Uh, which is not done today. Uh, one of the things that uh, many countries do is they take so-called capital gains. So it's like if you buy a property, you sell it, ten years later, you make $,. You can pretty much put that in your pocket. Okay. Uh, whereas in the United States, in Australia, uh, in Europe, you have to pay tax on that. Okay. Uh, doesn't mean our system is better or worse, but it's different. And, and, uh, you do see a lot of differences in terms of some of these numbers. Okay. Another interesting thing to look at. And I do it again. Interesting is a relative term. Okay. Interesting. In the context of your project, uh, is the revenue per employee in New Zealand okay. And so what this means is if you take a company like Becca or like Fonterra or like, um, ASB and, and you actually say, how much are they generating in revenue, money coming in, uh, versus the number of staff that they have. Okay. And, uh, if we look at this and there's obviously a range, uh, but this actually looks at it, uh, in terms of the number of companies at various levels. And so the, the highest point is, uh, on average for large companies, something like around , per, uh, staff member. Okay. So remember, of course, these are going to be consolidated across a whole bunch of different companies. Okay. If we actually look at this, uh, for specific companies, for instance a milk. So a milk is uh specialised milk. It's got a protein removed. Some people think it tastes better. Uh, so, so for a milk, uh, it's actually and this is, uh, pretty, I believe this data, it's about $. million per employee, and that's among the highest if we look at some of the energy providers, again, several million dollars per employee. So that's money coming in. And, uh, so let's say they're paying an employee or $,. So there's obviously a big difference between that money coming in and what they're paying someone. But most of these say in terms of the energy producers, uh, they will have a relatively low what they call operating margin. So they might be bringing a lot of money in, but they're also spending a lot of money, say, to produce power. Okay. And so if we look at this compared to, uh, some these are US technology companies, okay. And obviously these would be some of the highest revenue per employee in the world. So Apple uh, on this charts, the highest there are a few more that that are higher. But of of mainstream companies, Apple would be the highest in the world. So $. million for every Apple staff member is coming in the door in terms of them selling mobile phones and computers and all the stuff that we buy. Okay. And and, uh, if you know, people actually, I talked to someone in this, uh, course out

in front one day, uh, that was actually interviewing for a job with Apple. And, um, we talked about how, uh, the environment was and also how competitive it was to get those jobs. And so, uh, Apple is known as a pretty bougie place to work, but also pretty competitive and demanding. And and this will be one of the reasons why is because they actually expect quite a lot to be produced. Okay. And obviously you can see that for these other. Organisations, but these are the sorts of things that we think about when we look at economic activity in New Zealand, like, would it be cool if we had a bunch of apples? Or maybe not so much? Uh uh, I actually did live and work in the Silicon Valley for a while, and, um, it's a very intense place. Uh, minimal work life balance. Uh, you know, hard to find time to have a nice hike, things like that. So whether or not that's the kind of environment we don't have more of in New Zealand is a trade off. Okay. Uh, just to kind of capture a few things. Uh, we've had this strong GDP growth. But now, as I mentioned, we're in recession. Uh, also, uh, today about in Kiwis are homeless. So, uh, Raissa mentioned this, what's called the Gross National Happiness. This was developed in the country, in Bhutan. And and so if we look at this interestingly by the characteristics and he went through the formula a little bit, uh, New Zealand in the most recent. Let's see in , New Zealand is actually ninth in the world happiness. Okay. And obviously you can see the ones that are higher and the ones that are lower. Uh, but ninth is not bad considering, uh, New Zealand size and all the countries in the world. So is that something we would want to have more of and worry less about the economic numbers? So those are the sorts of trade offs that we have to consider. Okay. And when we look at Gross National Happiness and Raise, I actually went through this for me a little bit. But basically these are the key elements of it. And uh, kind of the, the, the history of it. And interestingly, although Bhutan first developed it, uh, eventually, um, they were not top on the list. Uh, other countries surpassed them looking at the same things. Okay. Uh, I have a, um, colleague in the United States. And whenever he introduces something like new that like to kind of wake up the students, he says this is a big idea. Okay, so I'm going to do that with this and say, this is a big idea, and it's what's called doughnut economics. And this is another framework. And I've said this before, a framework is just a picture that kind of helps us to understand something. But this one was introduced by, uh, a woman called Kate Raworth, and she's actually been to Auckland to talk about this. Uh, and this is called Doughnut Economics. And basically what she talks about is that the challenge for any economy is to remain in the doughnut, and that is this kind of bright green bit. Okay. And because if you go if you push too far to the outer edge, uh, beyond the doughnut, what happens is you begin to compromise some fundamental natural systems. Okay. And these are some of the challenges that we face in terms of climate change, some of the impacts that we're seeing right now in terms of pushing the boundaries too far. Okay. And so, uh, what she talks about is if we go too far that direction, uh, we are significantly compromising the planet. And in fact, our ability to, uh, continue to live in the planet long term. If you go the other direction, you actually start to compromise things that are important from a society standpoint. So if you remember back, one of those early slides I talked about were a system of systems, one of which is society. And so, uh, New Zealand's society, and that's ranked pretty highly on a global basis, uh, is made up of some of these things, and these are the societal elements that, uh, raise a talked about on Tuesday. So we start to compromise things like housing, our access to water, food, health care, education, all the things we're talking about these days in New Zealand. And so, in fact, we're we're kind of bouncing on both edges of the doughnut, uh, and, uh, have risks of compromising, uh, the environment as well as have risks of compromising the social fabric. And, and so the challenge is actually, uh, not to go too far in one way or the other, but how do you actually

navigate the middle? And this will be a significant challenge for your generation in generations to come. Uh, I can tell you I'm not entirely proud of this, but back in the day when I was in uni, that was like years ago, um, we didn't even think about this. We should have been. So we didn't have the mess that we have created now. But we didn't think about this at all. When I had these sorts of courses, we would straight up talk about GDP and be like, let's crank that baby up, okay? That that was it was all about that. And we would really only consider what can we do to, uh, one of my professors used to say to goose that number, okay. And, and so it's way more complicated now. And when we introduce the systems thinking it's, it's a way more complicated, uh, um, undertaking to figure out what do you do, because there's no clear answers and there's lots of risks. Okay. Uh, so one of the things and in, uh, so remember, this section is called What Else Matters. Okay. And so this is just another thing to take a quick look at in terms of New Zealand is, uh, where we rank in terms of sustainability policies, a robust democracy and good governments worldwide. And, and so we actually ranked th in the world overall and, and or on sustainability. And then obviously these, these other numbers, uh, and and these are, you know, frankly damn good for a couple of islands in, you know, kind of the bottom of the Pacific. So we, we don't want to compromise some of those things in terms of the solutions that we do next. Okay. So what does this all mean in terms of, uh, how we're actually living day to day in New Zealand? How does this impact us and what you will need to consider when you do your projects? Okay. Uh, couple of other just like quick bullets is that, uh, and these would be things that you would know yourself. Um, our, our large firms are mostly not Kiwi owned. The banks are owned by Australians almost entirely Fisher Paykel Appliances, owned by Chinese company, uh, Rocket Lab, which was started here. Uh, is actually now the majority of their staff are in, uh, the United States, although they do still in place in New Zealand. Uh, so all these things. Okay, so, uh, much of New Zealand is actually owned elsewhere, and our biggest industries are facing some very serious sustainability challenges. Uh, most of New Zealand is made up of smaller businesses, uh, uh, so-called, uh, small and micro businesses. And many of those folks are self-employed. They have no staff at all. Okay. And you can read the the data there. Okay. So ultimately the government has to look at this. And one of, uh, the stakeholders that you'll be dealing with is the government in whatever form. So it might be the ministry of whatever, uh, it might be, um, even some, you know, things like Auckland Council, but but ultimately, uh, for New Zealand's government, there's like billion coming in and billion going out. Okay. So this is just like for your own, like, you know, current account that you pull up on the app for ASB. It's like, yo, a little bit of a problem here okay. Because we got this coming in and this going out. Turns out you can't do that forever because eventually there's going to be an overdraft. So, uh, you'll notice obviously the main ways we have money coming in are the taxes. All of us pay a little bit on companies. And then the GST, which is on pretty much everything we buy, right? Okay. But the big things going out are all people getting NZ super okay. Uh, social support to people who have needs that they're not able to meet themselves. Health care which are the um the health minister admitted this week that, uh, New Zealand health care system is in crisis. That's literally the health minister saying that, okay, education. And so all these things. And so we can't just be like, oh, okay, well, let's cut that one out and let's take those old people and just pull their super, okay. By the way, I'm just just about coming up on that myself. Okay. So, um, like, you could just kind of, uh, pull that money back. No, probably that wouldn't work. So the challenge is to actually figure out how you would redistribute this or have more coming in, just like for you, because effectively, this is the government's credit card. And so if we look at, uh, this thing called Obi Gow, which is like an acronym that has

some big, long meeting, so long that I actually put it on my phone because I can never remember exactly what it means. Okay. Stands for operating balance before gains and losses. The total difference between, uh, government revenue and expenses number we hear mentioned in political and media reports all the time. Okay. So, uh, basically these, these, uh, like, downward blue lines here are years in which we are spending more than we have coming in now. It's projected the current government actually projects that this is going to turn around, and that we're going to make just a little bit of a surplus. We're going to have a bit more coming in than going out by . Okay. And uh, then the other thing that's interesting about this is the percent of GDP. So remember we just talked all about this nerdy GDP stuff. Uh, but what's the percent of GDP that we have borrowed. And so this is no different from like if you are working in a job when you come out of. Here in the grad roll, and you're making $,. Pretty good grand roll necessary in software engineering. That would be higher. Okay. But, um, so let's say you're making like ,, okay. And you have to pay a bit of tax and stuff. But then you'd think about what's the percent of your own income that you could borrow without freaking out. And so today, New Zealand is at about % of our GDP that we're borrowing. Okay. And so it's like, whoa, should we freak out? Well not compared to many of these other countries because these are all countries that are borrowing way more than that percentage. So even though we are borrowing may not be, uh, something we need to, like, freak out about. And this is kind of, uh, the history, basically the history of our credit card balance over time. And, uh, as you can see, it was up even higher where than where it is. Uh, it it returned to a much lower level, and we're kind of on the way back up again. Okay. And so what does all this mean? Okay. Uh, and, and, you know, actually, um, there's this guy who wrote all these books, uh, he's called Tom Peters. And way back in the day, he was like one of these, like, guru types that, um, wrote all these books about what the future was going to be. And then he was an American, but, um, he eventually became a, uh, professor here at the business school at the University of Auckland because he has a batch in Nelson. So he would come to New Zealand and he has now retired. And that dude's must be it. Well into the s by now. But, uh, he, he used to do these big, long talks and people say, what does it mean? And, uh, he said, beats the [INAUDIBLE] out of me, but something is happening. Okay. And that's pretty much what we're saying here, is that all of this information creates a foundation, and it's part of what we give you in order to look at what what should we do with a problem going into the future? But the fact is, you can't predict exactly what the future will be. So you have to come up with a solution with imperfect information. Okay. So there's many things that play into this, uh, economic strength might happen at the expense of the environment. Uh, almost certainly it will, uh, or the well-being in terms of some of these things like health care and education and, uh, there's there's other ways of looking at this as well that are being discussed. And most importantly, a systems level problem, uh, to solve requires trade offs and vision to drive real and transformative change. And that's what we're really asking you to do in these projects, in your team, is to figure out how can we make transformative change around some big problem? Okay, so, uh, that is the background for this. Uh, before we wrap up, I do want to just, um, show people what's coming up. Uh, okay. So, uh, here's the canvas. And, uh, so just a heads up that next week on Monday, Mark is going to talk about the social CBA. So Mark, uh, on Monday this week talked about a traditional, uh, cost benefit analysis. Now, uh, he's going to tell you, how do you, uh, roll everything into that? Okay. And then on Tuesday, we have this, uh, special guest speaker, uh, she's called Dame Professor. Pretty big title. Okay. Dame professor Juliet Gerard. And she was the, uh, previous government's chief science advisor. So she was in that job all the way through Covid stuff. She's going to talk about the way they've navigated systems

thinking for some very major government problems. Now, people ask about the mark that's related to participation in this course that happens that day. Turn up. You get % on the day. Don't turn up, you lose %. So if you've been blowing off this course, those of you watching, uh, you should turn off on that day. Okay, so just a heads up on that. Another heads up that beginning in five minutes, the, uh, quiz quiz one for this course opens in five minutes, and then it remains open till ten tomorrow evening. So find an hour somewhere in there and take the quiz.

Lecture 10
We got a lot to get through today. So we're going to be covering social cost benefit analysis. So taking what we learned about cost benefit analysis what you learned with Risa about social considerations. How do we tie those all together in the business case. Compare the non-monetary with the monetary and uh, report those to the decision makers. So last week, traditional CBA societal considerations and GDP at the government level, at the national level, need to be thinking about both where the money is coming from as well as the non-monetary impacts as well as the monetary impact. So what got our social CBA lecture today? Tying everything together. Then tomorrow we've got Dame Professor Juliet Girard, the chief science adviser to the prime minister during Covid for Cardiac Island, uh, during the last government. So come along to that. There is a participation mark associated with that that you'll only be able to get by coming to the lecture. Um, yeah. Huge. Pretty huge guest lecturer, very, uh, esteemed speaker. So please come along. You'll learn a lot. Really see what this looks like at the highest possible level when you're giving advice like these business cases to the decision makers. So come along. Definitely worth your time. Uh, make the team so you'll meet your teams that you'll be carrying out your team project and your systems projects with. Um, again, there is an assignment attached to that, the team canvas. Uh, so come along, mate, at some time. This lecture room is free during that time. So you can come, uh, here or if it's here or wherever it is, the lecture theatre is available. Come meet the team. You can also do online. Um, but just make sure that if you can't make it for any reason that you inform your team, let them know where you're at. Touch base, make contact. Okay. Anything else? Check out this week's announcement post on Fridays. Uh, it'll tell you everything you need to know. So learning outcomes for today identify and differentiate between those economic and non-economic that monetary and non-monetary impacts. Um for systems level project monetise quantify or qualify those impacts using the cost benefit analysis spreadsheet. Uh the living standards framework as well. You've already looked at what that is. So we'll be using a how to apply that today. Discuss how economic and non-economic impacts are used in decision making. Really important there. How do you summarise these things that don't really seem comparable? How do you summarise those? So the people who need to make those decisions and what's uh, agenda for today running through those impacts, monetary versus non-monetary discussing what those are and then looking at um, again how those are reported. How are those compared. We'll look at Auckland light rail, City Rail Link I know that they're both rail. They're both transport cases. Transport cases are just they have the most out there. They're the easiest to get your head around. So yes we're using transport projects. But these can be applied to many different projects as well from software um through to mechanical design as well. So we looked at the financial case last week. We looked at the steps for the CBA to find the policy alternatives in the counterfactual, the counterfactual being either the do nothing. So the thing that you're comparing it to or it can be another situation. So maybe you're

comparing option one to option two, or you're comparing your best option, the preferred way forward to do nothing. It's just basically what are you testing against? What are you testing against that counterfactual identify who benefits and who gains, uh, who loses done through stakeholder analysis. You'll identify those based on your problem analysis as well. Identify those costs and benefits and discount that allocate those the time periods value those benefits and discount those benefits and impacts. We'll focus most of our day here identifying and trying to quantify, monetise or qualify what those impacts are also touched briefly on discounting. And then we'll look at how those are presented. So once have identified who benefits and who loses through your stakeholder analysis you need to identify, monetise, quantify and or qualify what those impacts of your solutions are to those stakeholders, to the people who are impacted by those solutions. And social impacts can be either monetary, measured in dollar terms, or non-monetary. That can be quantified or qualified. And we'll look at that in a second. So monetary impacts. So those benefits and costs are expressed some money terms of money dollar terms. New Zealand dollars also known as economic impacts. So you'll see those two terms thrown around a bit in the business cases. Economic monetary in terms of money. They're obviously quantitative because they're in terms of money. They're in terms of numbers analysis mainly through the cost benefit analysis and what we call the cost benefit analysis spreadsheet, which we'll have a look at today. The non-monetary non-monetary impacts. So these are things that are not expressed in numbers but they can sorry not expressed in dollar terms but they can be expressed as numbers. So they can be quantified. Or if you can't quantify them that qualified or more qualitative so expressed in words discussion. Uh we'll look at the multi-criteria analysis which is a tool that kind of helps you to compare these non quantifiable and quality quantitative um terms and mainly assess through statistical analysis for a quantitative assessment on those um numbers that are not money remember. Or it can be a discussion a more qualitative analysis holistic view looking at those um expressions. So we'll look at what a multi-criteria analysis is. And this analysis can take into account both quantitative as well as qualitative data. You need to identify both of these impacts before trying to value them. How do you identify them? Well, when you carry out your problem analysis, you will identify through that analysis. The main areas of well-being that you'll most likely be impacting. So if you've got a project in the health sector it's going to impact health. If you're in transport, it's going to mainly impact transport impacts, but it also impacts other impacts that may not be as directly correlated. You can consider those the more wider benefits. Um, but these are mainly the areas that you'll look at. So if you're working in transport, transport, health, health, education clearly going to have impacts on education. The monetary impacts can include any revenues produced from the solution. So if you have for example we'll look at City Rail Link. Obviously city rail link charge will charge or any rail link will charge money to use that service. That will generate some revenues. Those revenues will be used to offset those operating costs. So when um, you have your maintenance costs, your ongoing costs into the future, those will be obviously offset by any revenue that you can make. You have your capital and ongoing costs. When we talked about this last week in terms of dollar value, what's the capital needed to, um, bring a project about? And what are those ongoing costs from production start all the way to end of life. So think of a holistic life cycle analysis. You may have covered lifecycle analysis before. That includes both the build out as well as the operation. We remember we covered cost savings and just benefits. So this also is included here. Any future cost savings by putting out your um innovation or your solution as well as, um, any dust benefits or detrimental benefits that can come about as well. So for example, we use the bridge example if you're building a new

bridge. Yes, you have a higher capital cost, but you're going to be having savings. And the fact that you don't have as high maintenance costs for a newer bridge compared to an older bridge. So, for example, uh, any impacts on wellbeing that can be monetised. So those economic impacts and we'll look at how to monetise those impacts in a second. And these are identified through the cost benefit analysis and the living standards framework that we covered last week. So the Living Standards framework have your domains of wellbeing. What domains are you going to be impacting with your solutions. And then what is your impact on the four capitals at the bottom of the Living Standards framework? There is always an impact on those as well. Non-monetary impacts can include quantifiable but not monetizable um impacts. So you may find that you can put numbers to it, but you might not necessarily be able to put a dollar value to it. That's okay. You should still include that in your analysis. Bring that forward. Non quantifiable impacts things like impacts on those domains of well-being that can't be monetised. Discussion around the four capitals things like that. That more of a qualitative nature. And they're identified through things. Frameworks like the living standards framework. Health New Zealand has another framework that they use where they identify five domains of wellbeing for health specifically. There's another one here out of order. It's another framework used that you can use as well. Measures impacts on more Maori to Maori domains. Um, I just want to cover this idea of ordinal variables. So when you rank or give a weighted score to something, maybe you highlight it low, medium, high, or you rank them from, you know, if you have a number of options you like, option one does the best stick and does the best. Maybe that fifth option does the third best. These are called ordinal variables that categories that are ordered. They are kind of in the middle of quantitative and qualitative. While they can have numbers to them, is unquantifiable sort of. They're more qualitative because you can't really do much statistical analysis with discrete categorical variables. Maybe you can find an mean or an average or a mode, but less applicable than a full statistical analysis that you could carry out on quantifiable variables. So just remember that ordinal variables, making categories and ranking things more qualitative and quantitative. You can't do that statistical or um, formulaic analysis that you can do with a quantitative variable. That's important when we get to multi-criteria analysis. So some examples of that can include things like the number of hospital beds. But as you'll see in the cost benefit analysis spreadsheet that's put out by Treasury, they can actually put dollar dollar values to this. So I've taken these things that same kind of qualitative. And they've used um, data from across the world actually mainly from Australia, to quantify or monetise what those impacts actually are. Things like hospital patient visits, um, visits to the emergency department, uh, even things like the health impact of a person, a single person biking every day instead of using a car. You've got emissions. You've got all sorts of stuff that, uh, monetised from the Cvac spreadsheet, which we're going to look at in a second right after this. And then you've got the non-monetary, quantifiable things like age, weight or height, and then you've got qualitative things like colour, taste, smell, things that you're describing the quality of. I'm sure you've seen these already, but just to reiterate recap as an example, height quantifiable height would be cm. A qualitative analysis of height would be hey, oh my, you're the tallest, your second tallest, your third tallest. So you're describing the quality of the information in terms of what? So just important to cover that there. So when we I did. So the first steps to to monetising impacts we want to identify those impacts first. What are those impacts. What are the domains that those impacts are having an effect on. We identify that counterfactual. Like I said before, they can be a broad range of impacts. So here you really want to identify all of the little pieces that have an effect or are affected by your solution. Some of those will be able to be

quantified. Some of those will be able to be monetised. Some of those won't be able to be monetised or quantified. You just need to do some sort of discussion, some sort of qualitative analysis on those. Once you've identified them, try to oh, sorry. And those are identified through CBA and living standards frameworks, those domains that we've already looked at. Once you've identified them, you can try to quantify them where possible, quantified but not monetised. Have your assumptions list those assumptions. This important thing here evidence base all of these, um, impacts using the CBA spreadsheet. They need to have evidence behind them, and you need to be able to describe that evidence. How good is your evidence? Why have you made that assumption? And how do you know that that assumption is the right assumption? How accurate are those assumptions? Are you and, you know, are you in with the order and one order of magnitude, or is that sort of or orders of magnitude away? Quantifying does take a lot of time. It can be difficult. Hence the need for things like the CBA spreadsheet put out by Treasury to try and help to monetise some of these. Then once you quantify if you can try to monetise them, that allows you to compare them in a cost benefit analysis, you should be able to monetise in some way the primary impacts of your solution. So for example, in the past we've done um, climate change. So one of the biggest impacts was going to be preventing further damages or catastrophe in the future. So how do you monetise that. We'll have a look at how they did that in the previous, uh, systems examples. Then modelling discount. Make sure it's in present value dollar terms really important as well. So Livingston is framework already covered, but the domains of well-being, they're monetizable through the CBA. Now I keep saying CBA and I haven't introduced it yet, but we're going to get there. But just understand that the CBA spreadsheet is a way to try to monetise some of these domains. That seemed very qualitative when you first look at them. So it's a way for decision makers, for people that give policy advice, to not be comparing apples with dogs, trying to get apples to oranges, apples to apples if you can. Before capitals. Largely, the effect on the four capitals will be more of a qualitative assessment. If you can get numbers, you can do a quantitative assessment mainly assessed through multi-criteria analysis, uh, which we're going to look at as well. Yes. That's right. So. Actually we'll look at the impacts database. Just a link there. If you want to have a look at the dashboard you can jump in and have a look at that. Click on it shows you the indicators, shows you what the quantifiable indicators are. All right. So KBA spreadsheet. This is a tool that was put out by Treasury I believe in . There was an update in which made it much, much more, um, comprehensive. But basically it's a database of values for impacts to monetise. Sorry to monetise the impacts on those domains of wellbeing. It allows for a consistent approach to cost benefit analysis through common values. So if you've got a bunch of different, um, joint ventures that are doing tenders that allows them to have similar or basically the same assumptions and values. So when decision makers look at the different options, they know that they will use similar assumptions. So they know that they're comparing apples to apples pretty much. They don't need to worry about one of the one of the big assumptions that are underlying this cost benefit analysis. It takes a long term and broad view of those societal impacts. So it does cover those domains. Monetise and discount those impacts where possible. So it allows for that because it's in terms of money. And we know through the time value of money that we need to discount future benefits, future impacts to the two today's values again gives that transparency. The decision makers know what the assumptions are of the evidence and the evidence base that underlies it. And then this reverse analysis. Now if your evidence base is not good enough, is pretty shaky at best, maybe very common amongst very new technologies that are trying to be put forward in a proposal instead of doing the normal

here's our benefits, here's our costs. This one does the best. Instead you say, okay, if these are our costs, how much benefits do we need to have a possible option or a good solution? So you might say, okay, we need to make a thousand new doctors or we need new beds in this hospital. This. That's the amount of benefit that we need to justify that amount of spending. If the budget is put forward, say, okay, here's $ million, you need to make $ million in benefits. So you can do reverse analysis as well, but only when usually it's only done when the evidence base for your assumptions and the cost benefit analysis are a little bit wild. So for our cost of this much, how much benefits do we need to generate for the project to be worth it? You need to spend this much to make a substantially greater benefit. Cool. Okay. So we'll look at the impact database. So this is a screenshot from the spreadsheet. And I'll jump into the spreadsheet in a second. It's a very very large model. Basically has all these tabs really for you in Systems Week. Or we want you to look at is the impacts database. This is where it gives you quantifiable or in this case monetizable. They've monetised those impacts on those domains. So you can see here if you think about health as the wellbeing domain, the cost to the health system from a fatal crash is $, per incident. So that's a dollar value that they've given to. If someone gets into a fatal crash, what does that financial burden on the government on the health care system? It might seem a little bit callous, but it's important to be able to try and compare, like I say, dollar to dollar values, and we'll talk about something in a second that'll kind of reiterate that point. But I just want to jump in and see what else we can look at. This works. It may or may not work. You can't do it. It's not like that. Oh, that's not cool. Okay, so this is a spreadsheet. It's an Excel spreadsheet, right? Gives you a little introduction to everything here. You can have a look at any of these, um, links if you like, just to give you a bit more kind of flushing it all out. But if I jump into the impacts database here, this is really where you want to be looking. So you can have a look at these wellbeing domains. You've got filters here. So if I want to look at just health. Have a look here. Okay. We've got all these different health impacts. I think there's around total monetised impacts on the spreadsheet. So everything from an ambulance call out thousand dollars burden to the government per incident. Um, things like the total costs of a health care for person with diabetes per year, around almost $,. So what we need you to do is to take a look at these impacts, depending on what the team project or what the systems brief is telling you about what impacts are relevant. So we've got health. Let's look at site environment or and let's look at leisure and play. And safety. So you can see things like that. So you've got some stuff. Quite morbid stuff. We're gonna talk a little bit about this, but this says that the social cost of a human life is almost $ million a burden. Serious car crashes, all sorts of stuff. Robbery. Almost , per incident. Now, this is taking to account everything you're talking about. The resources from the police, admin resources. Um, any costs and associated costs with that are are included in this one number. Okay. So what you want to do is you want to have a look what's relevant. Check those impacts. And then in your analysis you want to be looking at how many people this unit here is important. Is that how many people that you saved or how many people that you affect. Maybe it's how many incidents you reduce. Maybe it's waiting times in the hospital ID or whatever you're looking at in your analysis. You need to match those units and then try to come up with some numbers as to how much damages you're saving or how much benefits you're creating. So really important there. And if you like, you can have a look at how to model it. Basically what you do is you take these impacts here. You've got these numbers here. You input those impacts into this model here. So you've got your main impacts one two, three probably really only focusing on or at the most monetizable impacts. Usually or . Put those in with one thing. Uh, how do I scroll across? Uh. I don't know. Um, basically, you put them into here. And

you've got all of these, um, all of these informations you have to populate. Success rate segment of the policy intervention cohort. So that's how many actual people that you intend to affect year on year. You don't have to go through the whole thing of doing that. Just take the impacts from the impacts database and then use it in your analysis outside of the spreadsheet. What this does give you is it will spit you out. Net present value, um, costs. And it can even give you some graphs as well if I can find them. So you can have a look at this. It'll help you to, um, see what you really need at an industry for something like this. Not going to be going into that as much detail in your systems projects. But if you want to have a have a look at that, feel free. All right. Moving forward. Cool. Yeah. So what you might do is you might say, you know, you take the if you're if your intervention, if your solution was to prevent a certain amount or reduce the number of fatal car crashes, then you might say that the benefit is the number of car crashes that you expect to save times by that burden on the government, because that's the dollar value that they've said it costs the government a little bit callous to put numbers to things like this, but it is important that the decision makers are able to compare things like safety to things like convenience. And we'll have a look at an example next. So check the impacts database. Are impacts relevant to you. Try to monetise them if you can. If you can't monetise them try to quantify them. If you can't quantify them, settle with a qualitative discussion. The CBI is your best bet. It is difficult to monetise these impacts. Hence the reason that the CBI was born from Treasury because it's difficult to monetise its impact. So really, your best bet is to look at the CBI first. If you can't, you can look at some other tools. These are the things that are commonly used in transport. It's quite hard to find these tolls and other industries outside of transport and infrastructure. You can have a look, but best bet CBI that covers pretty much every industry that you could be thinking about. Um, for your options. If you can't, you may need to default to a primary or secondary resource. Um, so for two years ago in systems, they covered climate change. And one of the main sources that they used at the time wasn't, um, the impacts database wasn't as comprehensive as it is now, but what they used was the insurance payouts from, uh, the recent flooding events, and they extrapolated that and put a dollar value to that based on the situation today. So you can use things like insurance for damages. There are other sources, primary and secondary, that you can use to try and infer a monetised impact. Um, again what's important assumptions underlying analysis. What's that evidence base. So full disclosure next, the slide that we're gonna talk about next does talk about death. If you, um, aren't comfortable that maybe avert your eyes a little, but nothing there's nothing gory or anything. Just talking about the real life impacts of what your solutions can have on people. So the value of a human life. So basically this is Royal Oak Roundabout. If you've ever driven in Royal Oak Roundabout that's rubbish. It's you know you're always gonna you're if you're not having an accident, you're about to have an accident there. And so basically in , there was a report to remove the car parks that lead up to the roundabout because basically you're blind going into the roundabout because of those car parks. Those car parks are taken. You can't really see what's going on to your to your right. The report came out in wasn't implemented. That suggested removing of these car parks. . Cyclist is coming along. Driver opens his door. Cyclists either swerves or hits the door and is thrown out. And so the traffic line gets collected by truck. Unfortunately passes away. Dies at the same. Now, I'm not saying it's not a whether they should have implemented it or shouldn't have implemented it, but it's more about the fact that something that may seem trivial to you in what you're doing every day, something like a redesign of a roundabout. You may not think that it could, you know, lead directly to a death, but it can. These, um, upgrades have now been taken. Obviously, after that happen, those upgrades were made. But there is

always the question of if those upgrades were made before, what would what would have happened? There was potentially a chance to save a life, potentially a chance to save. Uh, what the government values as a human life. So really, when you're coming up with these projects, you need to weigh up safety against things like convenience, time saving. Um, things like satisfaction. That may seem qualitative. Congestion as a as a good example of that. So you've got time saved. Travel time saved. Easily quantifiable, easily monetizable. But then you've got congestion. How do you value people being pissed off in traffic because of congestion? Difficult, right? But that's why we have a spreadsheet to try and monetise some of these values. So then we might know that okay, the time saving by not changing the roundabout or changing the roundabout might not weigh up against or might be worth more if you save that human life. Right? So you need to weigh up these things that may not seem very monetizable. So how do we value a human life in the TVA has this thing called the value of statistical human life. They've got it in their cost estimations manual. The link that I just had up before, but the value of the human life was valued at around $ million in , based on a person survey. So these are bought out by surveys that they do. Do you think they would do them more often. But they're actually since not a doubled to . But from there up until it stayed pretty much the same up while up until Covid. Pretty much the same. So ,, in , . million just before Covid. And it wasn't until when the latest survey was carried out. So, you know, almost, you know, more than two decades ago since the first one and that person survey resulted in into to putting up the value of the statistical life to . million. So that's what the value of a statistical life is. If you're looking at transport projects. Uh, and New Zealand. So with that they're able to so they do the same thing with things like saving transport time. Like I said, congestion benefits, um, time saved, all that sort of stuff. And they make adjustments there as well. And from there they're able to compare, okay, how many hours saved, how much, how much satisfaction gained from less congestion. And then they need to weigh that against the value of the human life. Okay. So it can be a bit morbid but callous. But that's what has to be done. If you want to be making informed decisions about these latest level of project. Oh. Before. Yeah. So $.. Now up to . $ an hour to not be stuck in congestion. Yo, um, ask people what they think. Yeah. So they're formulated. That's, uh, survey. So they've changed a lot. That person survey. Yeah. It was just like, how much do you value human life now? Literally now it's more. That's too bad. I don't have the survey in front of you, but they're more in direct questions. So it's kind of like if you had this situation and you had this situation, which one would you value more? So it's kind of more indirect behavioural questions around how to value that human life. And then once I published that it's still up to the to they don't have to take that advice. They consider that million. If they wanted to, they could say to that million, million. It's up to them to take the information. The decision makers take this information and then they use it to come up with their numbers. There's obviously a trade off here. If you value the human life too highly, you're not going to pass any projects. So it's a balance. They need to be able to balance that enough that it's fair that they know how they're saving enough lives, but then they also need to weigh it against things like, you know, they don't want everyone to just sit in traffic all day or, um, a good one is the, the, um, speed, the speed limits. So there was another big, um, not a survey, but a business case done on reducing the speed limits. So, you know, you're weighing up things like convenience to things like safety. So you need a good basis to do that. All right. Jumping into some revenues. Uh, not going to go into any depth here on how to model these. I'm going to be honest. They get the big four to do it. A lot of modelling is contracted out and they carry it out for your systems projects. Probably mainly going to look at primary and secondary information, looking at similar, uh, similar solutions that have

been carried out elsewhere. Similar projects, similar scoped projects to try and get some of these revenues. You could also look backwards and you could be like, okay, if we cost this much, what is a reasonable, say, ticket charge for this rail system? So the revenue estimates. You can see here in millions of dollars. Falkland light rail for City Rail Link. Revenue is expected to be .. Meanwhile, costs are around million. So they have a shortfall of in the millions that they need to cover through budgets, through local council, through NZ three. So summary for in some way they need to try and find that money to cover them for that. So yeah, basically primary and secondary sources are going to be the best way to find some of these revenues. Or you can just do a bottom up calculation. You can say, okay, we have this many costs. What's a reasonable number that we can expect people to pay for the service. Uh, and then costs. We already covered these costs. So that P costs. So. So out there % chance it won't meet that. Discounted to today's money, obviously. But you'll compare those in your options assessment as well. Those shortlisted options. What are those costs. And then for City Rail Link these are some of the costs as well. So when I say you need to break it down you need to break it down into things like design professional services. Um has a has some resources around design and professional fees that you can use. Um, how much land do you need to purchase? How much is the building, the construction costs, all that sort of stuff. As well as that, there are some stuff that in CTA has as well. And then monetising these impacts. So looking at benefits you've got in this business case for light rail, you've got the traditional transport benefits. So those things like um time saved congestion. And then you've also got wider economic benefits. So you've got the idea that maybe um Auckland light rail once it's finished, if you have a station near a bunch of shops, there'll be some influx to the shops potentially of societal or some economic benefit. So that should be accounted for as well. So there's primary benefits all those. So traditional transport benefits. Reducing crowding on existing services. Just one say reducing crowding on other services. Because you transport you transfer people from some from another service to the service. Service improved quality of the service. So getting to the airport is now easier if the Auckland light rail got put in. So that's worth something. That's a benefit as well. That reduction in travel times obviously uh reliability benefits. So I don't know if you've ever caught a flight into international airport, but it's really difficult to try to get at Uber.   people jump off the plane and try getting to Uber, and it's surged bucks to get to town. That's not that reliable. Maybe the buses, buses, as we all know, coming to the coming to uni on buses, not very reliable. So the train service has a reliability benefit on top of those other options and then safety through new technology emissions benefits, stuff like that. Wider benefits. So agglomeration benefits of things like because you've got a new mode of transport that makes the city more efficient, there's going to be productivity benefits and to all the benefits and to all the businesses that are all along that line through more efficient movement of those people up those employees improved labour supplies so people that might not have been able to work somewhere. Now they can work somewhere because they've got a line to get to that work. Improved transportation impact on cost margins from companies. Again, similar thing more efficient transport, reducing congestion on the roads. And one area means that the freight or those things that have transport is possible as part of those cost margins are now cheaper. Okay. Just before I move on. Yeah. Ago you were talking about, uh, Tyson and uh uh uh uh, and he said, uh. And what do you like? You shop for the company. You have nothing but good luck. Wow. You were talking about the people coming into a place. I wouldn't be an inmate, so I wouldn't be able. Going to fight. Paying money somewhere else. Um, are you talking about, um, multiplier effect? Maybe. That we don't. So you don't consider the multiplier effect. So. So if you have risk. So if you have um,

people that are working somewhere and then they go work somewhere else. It's not as though you're employing those new people, right. Like they're just moving the employment from one place to another. Yeah. Not. Yeah. Yeah. But how is that different that someone is going to do this job? Isn't that tough to find? Well because they're creating opportunities to buy that stuff. That's the new it's a new opportunity, not a transfer. They're not transferring it. So it's a transfer. So for the tax and this is high unemployment, the people that are working are just coming from somewhere else to work where that's just that's just the tax the tax purpose of that. Not for creating new opportunities for people to go out and spend money or be, say, um, more efficient in the way they get somewhere. Yeah. Cool. Thank you. All right. Getting through where I have time. So, uh, for city by length, these were the benefits that were monetised here. Um, so things like total travel time savings often set in commonly used models, one hour sessions from the UK. I think, uh, might be from the UK, I'm sure, but the software to model some of these benefits as well, especially in transport. You may not find all of those benefits. Model label model label model label. Um, if they're outside of transport, you might you might not. Transport's just got a lot of, um, a lot of stuff behind it because that's a lot of, you know, transport infrastructure is a lot of what we do as engineers in society, the really, really big projects. Um, emissions, total emissions reductions as a benefit. You can do that. Pete is one of those links that I had up before Project Emissions, something t uh, you can use those to model emissions as well. Have a look at the slide length. Um, but again, just trying to just trying to monetise some of these, um, benefits, total emissions reduction and then just, uh summarisation you might want to use this as well as in your systems projects, summarising all of your benefits. Nice easy to read. What are the benefits that we were able to monetise. See here obviously they had is a lot. They spent millions of dollars doing this business case. I would expect you know if you get one good one that's great. You know if you can get two and three, that's good, that's even better. But you know, I'm very aware that you don't have millions of dollars to carry out this modelling. So just do your best if you can find one good one that's good. So for the climate change one and two years ago their main one was damages through catastrophic events. So savings in those insurance um costs. There are limitations to the spreadsheet. Not all impacts will be relevant. Not all impacts are listed on the database. Just check the database, see what's there, see what you can use and then go from there. If you can't move to other sources, primary and secondary. If you can find another modelling tool, use that. Probably unlikely that you'll be able to find anything as comprehensive as CBA. They need to quantify the impact based on the evidence. Sometimes evidence is not the best, especially when it's a new thing. Datasets can be incomplete as well. It does give an exact dollar value, so just be careful when you report the findings at the end. Remember that rounding error. Are you really modelling for the nearest dollar? Probably not. So just think about. You know it probably works out. If you're going to model it to , people, then it's probably going to round to the nearest ,. But just be careful of reporting findings that are like we're going to make exactly, you know, this benefit. All right. This brings us to, uh, multi-criteria analysis. Things like scoring frameworks, um, things like partially mates. Mate succeeds. You can rank options to exclusive. So you know you're not going to rank two of them as two. Or you can have a way of scoring. So you assign a one to a five to the various options. Maybe you just do green, yellow, red up to you to determine what that scoring framework is. Very common tool. Use it for the for capitals. This is a previous year's um example. Compare those uh so comparing both the monetary here as well as the more qualitative here important what impacts of the most important. There is always the impact on each capital. So make sure you include discussion around each capital for those qualitative impacts. Another example

of what they did. Um, qualitative assessment of what's going to happen to those four capitals as a result of implementing your solution. This is an options assessment that's also used in multi-criteria analysis. Yes, it's very long. You may think about rolling some of these many options into packages. That's what it ends up a lot of. This is not a short list. This is a long list. So you don't have to report this at the end. This is just part of the process. You got a long list. Short list. Do a full analysis on the shortlist I'm just put this up for example purposes. Finally full capitals. Always an impact. You must discuss an impact on all of them. If you do not, you will lose a lot of marks. Just here. Last thing. Um, the impacts of both during the build out as well as during operation, whole life cycle, not just not just the construction, not just the operation, but both. So clearly with these big transport projects. There's a lot of disruption. You. I was at a food thing the other day, and now telling us at the restaurant about the impact Corrales had on their business, and it's very significant. So really, really need to think about those impacts, not only in the not only when it's operating, but as you build as well. And these are some of these. This is the Auckland light rail options showing I'm I'm sorry I know it's very blurry but just showing some qualitative analysis on some of those impacts as well. Cool. We use a discount rate of %. Oh, there's still more to go. I think this is the last line. Um, yeah. Just the summary tables again. Examples of how to report that information, how to report those monetise impacts IRA be aware of it. It can be used. It's often not used in some of these cases. Um can be difficult to use but just be aware of it how to use it. It may or may not be in your systems projects. All right, just to wrap up. Compare those monetary benefits using the CBI if possible. If not, go to quantitative and qualitative analysis using multi-criteria. Look at the monetary and then quantifiable and then the qualitative. And just a final point too late into tomorrow's lecture. Even if you have a great business model, it might not get approved or even after it's approved, it can get cancelled by those who make the decisions. So just be aware of that. Professor Dame Professor Juliet Girard will talk more about this in her lecture tomorrow. Please come along. It'll be great. Really, really useful as you go on to industry. Thanks. Fo.

Lecture 11
I am extremely delighted, uh, to present today, to introduce today, uh, Professor Dame Juliet Gerard. And, uh, Juliet's got a, uh, Wikipedia page, so it's, uh, you know, you can read all about her interesting history, um, of of being a world class scientists, educated in Oxford, um, having worked in University of Canterbury and University of Auckland, um, and then, um, starting our own company nanofibers. Um, and then also, if that's not enough, also working as the New Zealand prime minister's chief scientific adviser, uh, since for the previous government. And she's, uh, recently, uh, left that role and, uh, she's going to join us as, uh, a permanent member of, of this teaching team, um, next year. So if you, if, if you, if you really want to, uh, uh, learn on, uh, Juliet, take this class again next year. But, um, I, one of one of the reasons why, uh, we valued Juliet's experience is in her role as, uh, chief scientific adviser to the prime minister. Uh, she has, uh, probably more than many of us, of all of us truly applied systems thinking to solving some big, complex problems. And, um, your in your assignments and what you're learning this class. Uh, I hope that by listening to Juliet, you can try to see where, um, where you're going with this course. Okay, so without further ado, uh, let's big I give a big, warm welcome to Juliet. Thanks. I spent in Kyoto. Koto, can you hear me? At the back? Somebody at the back waved to me. Yes. Thank you. There's some seats at the front, and I think there's an overflow for the people at the back. Um, I'm just back from my time as chief science advisor, and everybody said, don't do, uh,

undergraduate or postgrad teaching because no one turns up to lectures. So this is a thing of joy. I'm glad you're all here. I know they made it compulsory, and you have to do something with that, but I'm taking it anyway. So what? I thought I'd say, um, at Ashwin's suggestion, was just give you a taste of how science advice. And I've used that word all the way through. It includes engineering. I'm not trying to be exclusionary in any way. That's just the word that gets used in government in New Zealand. Um, and how it fits into government decision making. And as Ashwin said, uh, of all the places, government is perhaps the place you are going to find these big wicked systems, problems that need solving and whatever you guys end up doing, you're going to hit the government at some point. It might be local government, central government. And they're not just interested in your projects, they're interested in how it fits into the whole system. So this will be very skewed towards government, not business, but hopefully it provides some context. But whichever direction you're going in your career, I also thought I'd talk about how that changes in a crisis. So I'm going to go through, um, a topic, plastics, where it was a fairly standard wicked problem. It was fairly clear the process we had to go through to make recommendations to government, um, and all the different players. But then during the last six years, working for three prime ministers, there's been a fair few emergencies, um, more than I signed up for. So I thought I'd just give you a snapshot of what happens in an emergency, what changes how you have to to quickly frame your advice, and importantly, how to communicate that advice. And given that lots of people in the modern world are falling down rabbit holes full of myths and disinformation, I've just put some reflections in the end about how that impacted our advice during Covid, and it will likely impact all of you if you're giving technical advice and your career in any context. So this is the boring slide. When you sign up to be the Prime Minister's chief science advisor. This is what it says on the tin. You provide advice to the Prime Minister of the day on science in its very broadest sense. That includes all science. It also includes engineering. If you were in the UK, you'd be the chief science and engineer advisor. But we've just got science as a catchall. It includes math. It includes any systematic set of data and evidence that you might be able to use to inform good policy and good decision making. It is clearly a completely bonkers job description because nobody knows all that. And so the big challenge is to work out how to get the experts, get the expertise, the data, the right people around the table and communicate that information to the decision makers. So there's some more detail there. It's not just the Prime minister. It could also be other ministers and senior decision makers. I have this gloriously rose tinted view of politicians, because only the ones that wanted some science and evidence ever called, the others didn't. And so it's a very kind of selective process within the beehive. Who's going to respond to this sort of information? There's some bits about promoting public understanding. There's that third bullet point that when I took the role, I thought, what's the chance of that? What sort of alert function could we have? Boy, was I wrong. There was a lot of alerting today. And of course, not all the evidence you need is on show. So international relationships are super important. So this was the vision for the role. Not to try and be some guru, but to create a trusted bridge between scientists and engineers, society and government. Um, because there was so many possible questions, it was hard to come up with a framework for working. So we went with these principles of rigour, inclusivity, transparency and accessibility. If you put them in that order, you can remember them as writer. Um, I think that scientists are very good at being rigorous. They are challenged on the other three, and we put in real focus on how to include more views, how to be transparent in what we were doing and how to be accessible as people, and also make the advice accessible in terms of how it was delivered and appropriately for the audience. And

the challenge always for science advice is time. So scientists and engineers would like to have a really thorough think. Do some experiments, get some data and give a definitive conclusion. Perhaps in three years, perhaps with an invoice of $, with their work. The minister or Prime Minister asking you a question probably wants to get vice by Thursday or maybe next year. So those two timeframes don't marry and how you communicate what you do know. Importantly, what you don't know, when you might know that and how you might know that. Um, a really important. So keep saying we. It was a small office that we ran. Um, some of you might recognise Emma Brown, who joined us from engineering. The people that joined the team came from all backgrounds, political, different bits of science. Some had a PhD, some didn't. The way we hired them was to give them a pressure test. So to draft a briefing on a contentious topic over a weekend, um, and we just anonymously looked at them and pulled out the best ones, and it didn't pull out any particular background. It pulled out a type of person. And I'll also say we in the context of science advisors, there's the prime minister's chief science advisor, but there's also a bunch of science officers around Wellington and different ministries in different agencies and different departments. Um, and I've listed them here. And one of the things I worked hard on was making those people a team and co-opting people who had skills that were missing around the table. So that was the first plank in my bridge. If you like to get out to the wider community of people who could solve any of the problems that we might hit. So this is my kind of theory. Slide if you like. Um, and it's worth just reflecting on it for a minute. Because if you've had a technical training, you tend to come up with technical answers to the problem as you framed it. And if you're working on a systems problem, a wicked problem, something that's not easily defined and can be looked at in different ways. You have to remember that the science or the engineering is never the only advice. I think Covid gave the world an unrealistic snapshot of science, of bias in high profile. That was unique, and I'll talk about it shortly, and that we have an unknown disease and lots to discover. And so the role of science was huge. Normally it's not huge at all. Normally you're lucky if you can get at the table and put some data down. So understanding when the advice is useful and when it's really not useful and you should just get out of the way, is as important as doing the reports and the advising. Also understanding what science and engineers is good at. So you're good at defining the problem, say with the technical training problem definition is something that comes naturally to you in a way that it might not for people without the training. So even if it's a problem that's outside, anything you've ever studied, the way you've been trained to think during your degree will make a big difference. Um, and round tables, senior leadership tables, people really like that perspective. So the problem definition piece, scoping it out, not narrowing down your options too soon. Those sort of things come with the territory of having, um, an engineering or science degree. Very good at looking at different options and then really poor, as I mentioned at coming up with definitive, timely answers. So understand that, know what you can add and what you can't add to a decision making table. Then on the other side of the coin, you've got the politicians. Um, they need to make decisions in a frighteningly defined time frame, especially in an emergency. But anyway, the public's impatient. The media is impatient. Um, cabinet meets every Monday. If the decisions being made on Monday, it's being made on Monday. And if your report is two days late, sorry. No can do. So this that tension between the two ways of thinking and straddling that tension of the plural policymakers in the middle. So they're the people that are employed by Treasury or the different government departments. They're not elected. They work for whoever's in power. You will have heard on the radio this week that the PM is busy saying, we are going to redo maths. Um, that means that people in the Ministry of Education will be there till

midnight rewriting all the policies. They need to do that at pace. Um, and so they will have evidence from experts. They will have evidence from the ministers advisory panel. They will have a minister cracking the whip, and they have to straddle the two. So understanding the policy, the politics and the evidence is really important. So you know who to talk to when, who needs the detail. Who doesn't? And two last things on this one. Presenting facts hardly ever changes anyone's mind. You'll know this from when you read the press and you say, um, alcohol is bad for you and you get mad. So I don't believe that study. Whereas if it says alcohol is good for you, you are predisposed. Often I am to believe it, right? So, um, you have to really understand your own bias and other people's bias. Um, and understand the frame and the way people are thinking as you're providing the technical advice. And finally, people often talk about science as if it's of value. So science debate is just that. It's science debate. It might tell you how to save a rainforest. It wont tell you whether to save the rainforest. It will tell you the consequences of not saving it. Um, but it can't help, um, things like, um, the value of Freddi Frog and a mine. So other people will be making those decisions. Generally speaking, of course, as technical experts, you still have values. But be really clear to disconnect your values from your technical expertise. So the sorts of advice we got to give over six years. Um, the top one was what I thought we did a lot of that's the proactive stuff with recommendations. So engaging with experts, but also stakeholders, local government, central government officials, businesses, whoever you need for the topic. And I'll give you a taste of plastics. The hardest one was probably commercial fishing. It was a very commercially focussed project. Some people just hated the fact we were thinking about commercial fishing. And so we got a lot of, um, hostility just from the terms of reference before we even started. Um, but the plastics one was probably the most successful sell. Talk about that one. There was also a bunch of, um, what Jacinda called public facing explainers. So when she felt that people were starting to go down a rabbit hole first for G, but also for fluoride in nitrates, and then the thorny issue of evidence and drugs. So we did cannabis. She would call me and say, hey, do you think you just like, put up a website? Just the facts, just on this contentious topic? Um, and I'd say, sure. And then six months of my life would just disappear because those are the hardest things to write. So if you have a look at our web page, the links there, you'll see it's really simple language. It says, um, contentious and there's factual list we could get. But you need referees. Once you've heard them all, you need to go back to them or times. For some, they argue about the order of the the clauses in the sentence. It's like, how dare you put the comma there. The hate around those topics is so high. So really focusing on that communication is important, and there'll be many things that you will hit in your career where you'll get that too. You've made an assumption that you don't even realise you've made and, um, getting people to check it from all sorts of different points of view so that you haven't included triggering words and phrases and context makes a huge difference. And then the last type of advice, what's reactive? If something happened that we weren't expecting that does a few things. One is it takes all the normal things that are happening in government away. Um, if there's a state of emergency, you can do things fast. It's a quite, um, satisfying time to be providing advice because you can advice something and it happens. Also quite scary if it happens. Um, and all the normal roles and balances and checks are relaxed so you can get stuff done. Um, so very different context to the kind of peer reviewed long reports that we did the rest of the time. So I'll give you a quick taste of what we did on plastics. Um, so this was a massive project that we did. It turned into a big fat report. Um, so as long as the thesis, you can have a look at it on the web. Um, we had an expert panel. It included the business voice, the local government voice, NGOs. And the wonderful thing about this

project was everyone agreed there was a problem, roughly what the problem was, and that we needed to solve it. And this was the first project we did, and I learnt that different audiences needed different amounts of detail. So this was the full report. Not many decision makers will read a full report. I was blessed with a Prime Minister that loved reading and did read full reports. Um, not not all Prime ministers are like that. Um, some like the short report and, um, some like the really short summary. I'm not going to tell you which one was which, but I'm guessing you could guess. But it's it's kind of soul destroying to do all that work and have someone say, can you just give us the bullet points? So it's really important when you are presenting any technical report to any audience to understand the level of detail they want. So these six things were our headlines, and as well as that kind of level of detail, we also needed to brief all the officials that were going to implement and make it happen. In fact, we worked with them as we went along so the detail isn't lost. Um, and understanding the level of technical detail people want is important. So those are the six high level themes under the mould as quite detailed recommendations. The bottom one they're collecting data is probably the most important, also the least sexy. So we put it last. It's in every report. So whenever you're doing what everyone wants to focus the small budget on getting the thing done, not measuring it or monitoring it. But if you want to get funding to solve long term problems out of government or anybody, you need to be able to show that your solutions are working, your policy interventions and making a difference. So you need to really embed that data. Of course, you need to tackle health impacts, environmental impacts, and you need to grab all that best practice that's out there. All those little, um, Start-Up companies that are doing cool stuff and making it work and share it and scale it and amplify all the innovations that are around the country, both in terms of at the tech, the science, the engineering, but also the business model innovation. Um, and just ways people are doing things as a collection in the community. And we also had a go at asking the government to lead the way by leading by example, both in terms of showing moral leadership on an important environmental issue, but also because as the government, there's huge procurement, um, advantage. So they have massive budgets across all our public institutions and can really start to create markets for some of the alternate products and to do all that in a coherent way. You needed an action plan. So that was so great. This was pre-COVID. We had a lovely launch down at Sustainable Coastlines. Who are our poster boys for creating data from beach cleanups? We had a prime minister. We had a minister because we'd work carefully with those policy people as well as the decision makers. We had, um, things ready to announce and roll out. People who have been elected to office love having things to announce. So they announced lots of things on the day, and this is my best citation for my career. Um, so I'm supposed to like that one that's got sites in it in a peer reviewed journal, but actually, this is my proudest one. Um, we got a shout out from the from the general in the government that they were going to do everything in that report. So that was pretty good. Um, I'm scouting that all the other reports did not land that successfully, so I've picked this one for a reason. The one on gangs went away quietly. There was no mention in any Governor-General's speeches at that time. So we've got the immediate announced rebels, and we've got lots of press, and everybody's very happy. But to make things actually happen takes ages. And this is where lots of technical input needs to go into the ministry. In this case for the environment side, the officials, treasury, all those people can have a good look at the business plans, all the different capitals that they might be measuring and the living standards framework, all the advantages we might get from change, all the disadvantages and the unintended consequences. We tried hard to loop those people in as we did our work, so they didn't have to repeat it, but it's. Takes quite a

long time and the recommendations are still rolling out. So you have to think what's doable, what's scalable, what's implementable. If we're switching to petty recycling for trace, which we are. You need the plants. You need to understand where the pet is coming from. You need to make sure that if major companies like Coca-Cola change to glass, you've still got supply for your party. You basically need to make sure that when we get rid of that expanded polystyrene clamshell for your burger, you're not replacing it with something might have couple that oozes tomato ketchup on your lap. You're not poisoning anyone with PFAs. You've got a sustainable supply chain of alternate products. It's long. It's dealt, it's technical, it's important, and it's still going. So the great thing about the plastic report is it didn't get bent at the change of government so happily that in that was another. And that the trend of the recommendations being announced, that's the meat trace. And the delay between and was getting the petty stuff all sorted and the small matter of a pandemic and . So that's this year. New government. They've gone ahead with nationally consistent recycling guidelines that helps get the market sorted for all the source materials, and it means only one, two and five are being recycled onshore. A big step forward. Um, previously it was confusing. Different ones were collected in different local governments and people were confused and there wasn't enough scale in any one of those local jurisdictions. So that's how it's supposed to look for the second half of the lecture, I'm going to pivot and look at what happens in emergencies. Just to give you a taste really, of how you think you're working on commercial fisheries. And then something happens and you drop everything and then. So in an emergency, these four parts of the job description became really important. The independence of the role is important. So I did it as a secondment from Auckland University, which gave me some independence. That sounds irrelevant, but let's suppose, hypothetically, the leader of a country told people to inject bleach to cure Covid. It would fall to the science advisor if people started doing that to stand up and say out loud on TV, no, don't do that. That's the dangerous thing to do. And if you did do that, you'd probably have to resign shortly afterwards. And if you're on a secondment, then you can float back and still pay your mortgage. And so those things are technical, but important. Happily, I didn't have any prime ministers that told anyone to inject bleach, so the independence wasn't really needed. But it is important. And if you're employed by the government directly, you're bound by the Public Service Code of conduct, and that really limits what you can and can't say. Obviously, public understanding is important in a crisis, the science communication is critical. That alert function is on steroids. So my inbox would fill up, um, and overflowing with people offering to help, which was great, but also quite intense. And those international relationships were critical. So you really need that trusted, accessible bridge in place so that people feel comfortable approaching you with expertise. And the time scale is just nuts. So there is no time often to go and do proper research. You have to provide advice at pace. You have to caveat it that it's at pace, and you have to make sure that people understand that what you said on Thursday might be wrong by Sunday. Before you change your mind, if you want to keep your credibility. So the three emergencies I'll touch on briefly were the tragic events in Christchurch at the mosque shooting. More tragedy for Carrie White Island when it erupted. And of course Covid, which you will all have had direct experience of. So the mosque shooting was not something where I ever thought science advice would be needed. But of course, science advice includes a lot of social science. And while during the immediate aftermath, it was a time for healing. And the PM was leading, um, the gun reform and talking about unity. There were lots of social scientists in the background who were thinking, how do we recover from this? So in the recovery stage, it's really helpful to have experts in clinical psychology and counselling, social sciences of all type trauma, and

people who have got the cultural context to try and help a community heal, who are not necessarily, um, representative of those that the counselling community would see every day. So I went back to my Chief Science Advisor forum, Stuart McNaughton and Ian Lambert, both at the University of Auckland. They advise education and justice, and they both had really deep insights into what the scientific community could do to help. And Tahu Cook from Waikato, one of our co-opted members, also lent and to really help us understand in groups and outgroups and make sure that we weren't just looking through a Pacquiao lens, but that didn't give us the right expertise. So I contacted Mark Wilson, who is an excellent psychology lecturer at the UW. You may have seen him in the press. He does a lot of good explainers on issues of psychology, and he had, a few weeks after the event, gathered all the experts he could find, both nationally and going offshore to bring in Muslim leaders and people who understood trauma. And he was putting together an academic journal, which he called a rapid response issue, to capture how academics were reflecting at that time on the events and bringing in counsellors to see what the future would hold, how the research community could really get behind them to support recovery in Christchurch. Turns out that Jacinda was really interested in that, and I called Mark and we together turned it into a briefing. Um, and she read that on the plane when she went to Paris to meet Macron, to start the Christchurch Call, which you may have heard about. So that was a piece of very academic work from the psychology community that turned into a briefing in very quick time and actually informed the response. Um, Mark just kindly dropped everything and did that. And like me with the Governor-General speech, that it was one of the most satisfying things he done because, um, he felt like he was making a difference, not just waiting for someone to pick a book off a shelf later. If you're interested, you can read it. It's all linked story in the slides. Then the next emergency was completely different, but also tragic. Most of you will know that there was a volcanic eruption. Um, deeply unfortunate timing. And that some tourists were on the island when it erupted and guides and tourists lives were lost and there were some really deep injuries. So this was a really good example of the values and the technical insight piece. Everyone in this room will have a completely different value judgement on whether you should go and retrieve a body. It will depend on your cultural context, whether you're religious, just how you feel about about, um, that sort of thing. And that had nothing to do with the technical advice, but was weighing deeply around the table for the decision makers who needed to decide what to do. So again, back to my Science Advisor forum. Joe Jolley was one of the members. She's a volcanologist, and I think volcanologists have this weird way of communicating that other people don't because their careers are really quiet with sudden spikes. So she was on a plane overnight to London, but I still heard from her first that there had been an eruption. She wasn't there. And who to call? Um. Turned out she'd written a paper on for Katie. And this is the actual copy of the tattered paper that I had with me in the beehive. So I got called into the bunker, which is the emergency response unit on the basement of the bunker, weirdly below this tsunami line, about which you may wonder. Um, but that's where everybody goes. And this paper had been written to answer one question. Was it safe for staff to go and do fieldwork on the island? So there was a risk calculation methodology which had been applied to particularly Jane's staff to say, is it safe to go or not? And we were stuck in the bunker, in the beehive in these decision making meetings. And everyone had decided, yes. The value judgement was there was a priority to retrieve the bodies. Yes. We would take a risk. They needed to understand how big the risk was and they would go when quote said it was safe, unquote. And Jane's were never going to say it was safe because that's a valid judgement. So what they would say is we would not send our staff for fieldwork. And what was missing

was the understanding of risk appetite. So if you think about it, if they'd been, um, a busload of schoolkids alive on the island, nobody would have stopped to think they would have charged them to get them. Um, and if, um, there'd been nobody there or a suspicion that someone was said, that would have been different again. And so we had to separate out the risk appetite from the probability that there would be an incident on the island. So it turns out buried in this paper in figure seven, in a not very accessible way, was this hourly risk of dying from an explosion at different distances from the crater? And long story short, I, because I'm a biochemist, not a volcanologist, took one of the volcanologist, Graham Leonard, around. I called it, putting him in my handbag and taking him with me. Coming back to this piece about emergencies, you can't normally just take a random person into all these meetings, but because it was an emergency, I said, he's good. Trust me. He knows the island. He sat at the back, and this is just a page from my notebook that, um, I tore out. So I was in the meeting, passing the note back. He was communicating with gas. Um, and so when it came to be my turn to talk, I felt confident that what I was saying was correct. We spent a long time, um, in a short window, making these maps so that we could communicate to decision makers and to the public that, um. And the mountain was changing. There were times when it was safer. You should never go when it was red. There were times when you might be able to go and take a small risk. Um, in the end, the calculation was made that if we went in on that particular morning, there was a % chance of a further eruption that would cause fatalities. And the decision was made by the decision makers that that was an acceptable risk if special forces went in. So that was a very long morning. Um, obviously we haven't made the decision, but we've helped inform it. And Graham here was the guy that helped me in the meetings. Nico was the guy in the helicopter looking at the car while they were doing the retrieval, and if he saw anything or got sent any data that caused him concern, he could pull everybody out. And none of this would have been possible in terms of technical inputs without Sarah Stuart Black, who was a civil defence controller, goes by the name of Norm. He was listening to all the technical advice and weaving it in. There was also lots of support from the Volcano Science Advisory Panel, including this guy Tom Wilson. They made so much difference that, um, we ended up creating a position for Chief Science Advisor for emergencies. And Tom got that job, so he stayed on role. That's great. And these maps really changed the messaging in the media. So it went from, why aren't the government doing something? What's going on to it considered pieces about the best time to go in. So finally, just in the last ten minutes, I will give you a taste of the pandemic. This was a different crisis to the others in that it was a long, slow crisis. And generally speaking, governments are pretty good at short, sharp crises, but, um, less well set up for long, slow ones then there's quite a lot written on that. So everybody knew there would be another pandemic, but somehow we were all still taken by surprise. So in January , I got my first call from Patrick Vallance, which for anyone following the UK Covid inquiry, you will know that name. And he was gathering together a few international chief science advisers to find out, um, what everyone was thinking, what everyone was seeing and wondering whether this new outbreak in Wuhan was the big one. There was parallel information coming from the World Health Organisation into our Ministry of Health. And one thing that we all noticed in those first few weeks was that anyone who had a plan based on flu, so Italy, the UK, America, they were all in trouble. So anyone who thought this virus was a flu pandemic because they understood the flu, and because they'd written a plan based on the flu, their health systems were breaking and then they were locking down. Whereas some countries like Hong Kong, Singapore, Taiwan in particular were doing brilliantly. And so we had this small window where we could work out what to advise so that we minimise loss of life and

didn't make the mistakes that those other countries had made. And I say, wait, um, and town who was and is the chief science adviser for the Ministry of Health, he was advising Ashley Bloomfield. I was advising descender and for a long time my phone defaulted to calling and and vice versa. In fact, I had to look up his number the other day and and my phone and finally forgotten him, which was an achievement. So this was what was going on, um, in the places that had planned for flu. So when you get a pandemic, the problem isn't the number of people that are sick. The problem is that they are all sick at the same time. You get this curve number of new cases a day, and at some point you go over the health system capacity. Now that's a big problem because it means if you have a stroke, there's no ambulance. It means if you get yourself to the hospital, there's no bed. And so the number of deaths from the pandemic goes up hugely, not because people are dying of the virus, but because they're dying, because the hospitals are broken. So the plan was okay, take some basic public health measures. Wash your hands. We should have said wear a mask, but we didn't know that. Then don't go to big parties. Just tone it down a bit tame, and then not everyone will get sick at the same time. We won't get the superspreading events and you kind of limbo under the health system capacity line. The problem with us was when we looked at our health care system capacity in New Zealand, and it wasn't just us, we went in good shape, but it was true all over the world. There was no way we could cope. So that the exponential curve for Covid meant that by the time you understood, you needed to take measures, it was too late and the healthcare systems were just breaking all over the world. So we had to do something different. So what we did was pivot to the elimination strategy. And when I say that, it sounds like Ashley Bloomfield stood up in a meeting and said, pivot to elimination. That is not how it went. We didn't have that strategy. We had to make it up on the hoof. And, um, back to this emergency context. If you're in an emergency, all of a sudden everybody can brainstorm. So we had politicians, ministers, policy advisers, political advisors, science advisers, literally around the table and just send us boardroom with a couple of beers coming up with the elimination strategy. And in a nutshell, we were inspired by the system they had in Singapore. We had that on the table and we had to adapt it to the New Zealand context. So we made the loose, probably correct assumption that Kiwis, uh, much less well behaved than people in Singapore and we split everything. So the reason that our table was so, um, different from elsewhere in the world is that we acted really fast and that allowed for a bit of behavioural slippage. And it also meant that you didn't lose as many lives. So it was a lot easier to eliminate the virus if you started early. So all those decisions were made. Everything all the decisions were made in an astonishing hurry. Um, so that we could act in that we window. We had that little window of opportunity. So, to be clear, all the formal legislated advice came through Ashley Bloomfield and Caroline Mcelnay, the chief science adviser at an independent advice stream. And, um, a lot of people helped. So it was astonishing how much input we got in that little window. Um, I can't wave reports at you because we didn't have time to write any, but you can have a look at some doctors if you're interested in what happens in emergencies on the website. And I thought I'd just show you a few of the charts that were influential in some of the cabinet meetings that made decisions. So this is in that window where we're deciding what to do. I didn't write a briefing. Um, I just put some graphs on the table. So this is the total number of cases of Covid in a country since the first day was the first day a case was reported. Dodgy metric, but the only one we had. And you can see this is New Zealand just crawling along the baseline. This is the UK who were in trouble. Australia hadn't really committed either way, but this is what we were interested in. These countries here who had had cases but were managing them. So Hong Kong, Singapore, Taiwan. This analysis, the number of new cases each day, not total.

They all will be from here and again days since first case in the country. And this graph made a big difference to decision makers. So this was Italy, Iran. As soon as it arrived it took off. And then these are the Asian countries that we were really studying to try and see what they were doing that the other countries went. So happily we did it. You remember? Um, this is us on day versus the UK. So this was the nerve wracking first lockdown, and eventually we eliminated. This is what happened to the UK at the same time. I gave up with a log scale. I was somewhere near the ceiling in terms of the UK cases. And of course they locked down to just after the health system broke. And here we are against our benchmark country. So again that's New Zealand, Singapore, Hong Kong, Taiwan. Um we were in there with the pack so that was great. Later on international comparisons were still important. Um, this is us versus Victoria. So here this is when, um, people in Auckland in particular are beginning to get impatient. And we're doing that Delta lockdown the black. There is New Zealand's first wave that I just showed you weirdly overlays almost exactly with Victoria who had similar policies, similar population. And this was Victoria not managing to control that Delta outbreak because they did too little too late. So the virus was all ahead of their policy interventions, whereas we were very strict. So from um, a policy perspective of suppressing Delta, we did well as shown here. So this is New Zealand suppressing Delta compared to Victoria and New South Wales. Um, but we were losing social license rapidly. One of the reasons we were able to do that so well was because the genomics team at ESR managed to do a sequencing. So people sequenced cases all over the world to find out what had happened. But we were doing it to find out what was happening. So we knew that this person here, this wasn't a separate breach of my key. This was someone that had been to a party here because we knew the sequence of everybody's Covid infections and we could connect them. And that was used in real time. And the reason it was, was because Jacinda was super focussed on using it as a tool. And every briefing said, so what's the sequence? So where did they catch it? And that really drove our response. So now we're here. Thanks to vaccination, thanks to masks, our health system is straining, but now we are flattening the curve, which is where we always wanted to get to. So I mentioned communication at the beginning. This is a newspaper clip from the heyday. It's at the, um, the part of where we've eliminated where we're all at the rugby and the rest of the world is all locked down and hoping that their relatives are not too sick from Covid. Um, there was some early evidence that in New Zealand and Australia, trust in science went up. So people like Stacey Wiles did some amazing work to explain to people what their individual actions could make a massive difference to their community. We had decision makers that defer to experts. Um, Jacinda was very focussed on communicating the science and making sure the messaging was lined up. Um, this was a Facebook, uh, video that she got me to do with Michelle Dickinson, which was fairly terrifying because there were a million views really early on. She had a big science focus. So New Zealand's early communication, especially science communication of Covid, was written up by lots of social science critics as being exemplary. Everybody said, yep, that's how you do it. But as the crisis got longer, that early communication became less appropriate. We got a fair bit of anti expert backlash. Uh, many of you will have heard Stacy talk about the personal abuse that she got. So we had this kind of middle phase where the science communicators were being awarded and lauded, but there was a groundswell of people who really didn't care about the science. They thought their personal freedoms were more important. And that culminated in the protest. And when you get to the point where you've got riot shields holding up a graph, is it really going to help? So that's something to reflect on when you go in with your technical details for any problem. Do people actually care about the technical details? Um, and how could you frame that

messaging so that it's less triggering to people who are anti-sex? But. So this is my favourite graph. So the policy objective was to reduce the number of excess deaths. This is just a graph from a world in data. And New Zealand is at the very bottom. In fact, we lost fewer people during parts of Covid than we normally do because it was no one on the roads and we also shut down other infectious diseases. We also, for the most part, had pretty short, sharp lockdowns. But none of these people remember or accept that. So again, thinking about alternate realities out there on the internet is something to keep in mind when you're offering any advice in any context. So I'll leave it there this time for a few questions if anyone's got any. And then I've also got a few reports that just cover some of the stuff I've talked about, if anyone wants to grab them. Thank you. Thank you. Thanks for the trip down memory lane. Um, questions for Juliet. Uh, yes, in the front here. And then. Should I recycle my water bottle caps? That's the question. No, not until one of you guys invents a way of not having them clog up the sorters. Okay. Well, same with icecream tablets, weirdly. Yeah. Next question over there. You are from New customers where you talked about the dog days. How should. Uh, thank you John. I feel like we're basically seeing not just science mistrust about science, and I'll. That's about right, because obviously the bottom line is compromised and having a lot of us. Yeah, it's a good question. So, um, I hinted at at the beginning. I tended to work with ministers who had actively sought advice. But for every report, we offer a briefing to all members of all parties. Um, and there were a couple of times where I got lines like, thank you for this academic evidence, but we've already decided we don't need it. Um, so that is a challenge. The way I personally was funded was to try and open up a conversation about how to get data to see if the policy they were suggesting was successful. So there's usually a way in, but it's it's far from trivial. And if you've got a prime minister that doesn't want science advice, they won't have a science adviser say it. Building good relationships and accepting that not everybody's going to want a report is an important part of the whole cake.

Lecture 13
Quick learning outcomes, discuss the most important aspects of the business case and the context of government projects and mega projects. Major projects might hear this term thrown around projects over, uh, certain threshold monetary value. Describe the logical flow between the different stages of the business case. So we've touched a couple of times on the bit of business case framework. So we'll be going through that in more detail today. Um, be able to write a business case linking those problem spaces to that solution space. Oh so the implementation plan again, we already mapped those three spaces to what they look like in the better business case. When we looked at the traditional KBA carry out initial options assessments against the critical success factors, um, as well as that DB framework. Again, we'll look at that. Uh, really important for the team project coming up. It's a quick outline, um, business case of the systems level, business case methodology. And we'll go through, um, some structure using some, uh, cases such as Golden Mile, which is a case, uh, in Wellington as well as Auckland light rail, which we've already looked at. And the uh cost benefit analysis. So last week you had the guest speaker time, Professor Juliet Gerrard. Hopefully a lot of great, um, takeaways from that lecture today, looking at business case analysis, then jumping with Risa into resource research and resources, and then back to Amanda to introduce that team project. Uh, quiz two opens Thursday. That's coming up. Make sure to review for that. So business cases. Business cases make a justification for undertaking a project. Projects that are very large, projects that are very risky. They

evaluate the benefits and the costs and the risks of the options, and presents the rationale for the best way forward or the preferred way forward. Um, its purpose is to, um, get approval and investment from the decision makers that need to fund it. They can download O-levels. So at three and or you did a BC or BB innovation now and or looking at the business to government level or the systems level. You look at simple problems, simple way, simple problems for business to business, business consumer. But and for a three we look at what could problem. So problems that have stakeholders that have conflicting requirements. How do you manage those requirements. How do you balance those requirements to select the best way forward? So just to talk a little bit about the difference between the indicative business case, the program business case, the detailed business case, and then the final full implementation case. As you know, the better business case has the five cases. You start off with the program or the indicative business case which is largely based around the strategic case. What is the argument for change? Why do you need to solve this problem? How big is the problem? Who are you solving that problem for? And then as you move forward, you start to talk about the other cases the economic, the commercial, the financial. And then once you had the full implementation business case, you're able to have a full case for each one of those five cases. The reason for this layout is so there are off ramps. You're not committing to a full business case, which can cost, you know, tens of millions of dollars, hundreds of millions of dollars in some cases. It gives you an opportunity to assess the opportunity for these cases. And then if they're deemed or if they're deemed that you don't want to carry them forward, then you have an opportunity to scan it there so you don't have to go straight to the full case, the full implementation, which does cost a lot. You have opportunities to have checkpoints where you can either go or no go. So avoids the over commitment and reduces the losses of the project does not move forward. So today we'll look at a couple cases. Oakland light rail. That's an indicative business case. What we've been looking at. And the Golden Mile, which is an infrastructure project based within the Let's Get Wellington Moving program, which was recently dissolved, as we'll talk about in a second. Uh, but the Golden Mile is, uh, Golden Mile is a stretch along Taranaki Street and Wellington. If you've ever been to Wellington Main Street there, it's about removing or adding bus lines, removing or adding car parks where appropriate and changing the layout of the footpaths. I was actually involved in my old company reveal. I worked on the pre works for this case, uh, carrying out utility surveying. So basically you map all of the utilities under the ground. You need to know where the utilities are so people don't hit them when they go to do the construction. So we actually spent uh, three weeks working nights in the middle of Wellington, six, p.m. to a.m., mapping all of these utilities in the middle of the night. Very cold winter. Um, it was a great experience. Um, so yeah, cool to be able to bring this back and share this with you. So first up, we've mentioned the Treasury a lot. I just want to give you a little background about what the Treasury is. So the Treasury is the government's lead economic and financial advisor. They provide strategic policy advice on the New Zealand economy. Uh, they also look after the government's books. They're in charge of, um, rolling out the budget. All of these things around fiscal strategy, economic analysis, as you've seen, they develop the better business case model, pulled that from Britain and have obviously, they lead the policy advice to any of those, um, sort of larger cases. They're one of five central agencies. So central agencies are agencies within the government that provide advice across all sectors. So they're not just, you know, Ministry for Primary Industries or Ministry of Transport. They provide, uh, advice across all the industries. Hence the reason that I call the central agencies alongside the Department of the Prime Minister and Cabinet, the Public Service

Committee, the Ministry for regulation and the Social Investment Agency. Their key business objectives being fiscal, monetary and regulatory frameworks that result in stable, sustainable economic development. They handle the Crown's books, the finances, the budgets, the balance sheets, income statements. And they provide the regulatory frameworks to, um, support the state sector. Mainly, they're in charge of providing or facilitating the the improvement of inter-generational wellbeing for all New Zealanders. Okay. So important Treasury. They put it out of a lot of of us. We follow that advice here as well. They're the ones that put out this bit of business case framework, which is a requirement of projects over $ million. So as we look at here, we've got the five cases. We've been over this before the strategic, the economic, strategic. Looking at the, uh, the case for change, the economic. Looking at the economic value of the options and the social value of the options, the commercial looking at who the vendors will be, what are those strategic partnerships look like? How does the public perceive this? Good. Then the financial, the fine details of how the preferred way forward will be rolled out and then the management case. How will this be managed? How will this be rolled out in practice? So, as we already know, focusing more heavily on those four cases for systems week, for your team projects, just looking at the strategic and the economic case, only your final output being your shortlist that you'll carry forward. If you were to continue on into, say, a more detailed business case, you would then analyse the options, other shortlist options. But for the same project, just looking at strategic economic case, getting to a shortlist and then and Systems Week, you'll carry on through the preferred way forward and a little bit of that management case that project management. How will it look as you roll it out. So just to walk through the methodology went through the outline. So your strategic case looks at the project background problem spaces. We'll cover these in a bit more detail in a second. Stakeholder analysis requirements and key success factors. Any of those assumptions and constraints that are important. The economic case that long list. So you carry out your initial brainstorm. Then you carry out that into a long list where you'll do some analysis of those options, mainly through the data analysis framework, as well as analysing against your critical success or your key success factors and your problem statements to output that shortlist. Then you carry out that social cost benefit analysis on those short listed options to get you to your preferred way forward. And then from the preferred way forward into the management case. What's that high level timeline. What's that roll look like? And how are you going to measure the success of that preferred way forward. And then you're always in a business case with a set of recommendations. How should the government or the client move forward from here based on the advice that you've given them in this business case? So the methodology follows this. Kind of timeline. Define and analyse the problem. So you'll look at the problem spaces. You identify problem statements and then you'll brainstorm options based on those problem statements. Identify those user stakeholders and those requirements from those requirements. Build your key success factors that you'll compare your long list options to, and then assist those against the DFB and the critical success factors to determine that short list. Carry out that economic analysis, and then determine which has the most value, both economic and social, and the best way to move forward with that, then into planning and defining how to implement that solution. So I'm just going to introduce these, um, cases before I hand it over to Peter. But I've got the Golden Mile. So looking at the project background, this is what the Golden Mile case had. So the Golden Mile project forms a part of the alguien, the Let's Get Wellington moving program. So remember we talked about program cases versus um, business cases. So remember the city rail link that exists within the Auckland Rails Links program similar to this. Um. The

geographical scope for the let's Go to moving program covers the areas from no longer a gorge to the Wellington International Airport. So when we did our pre works on the programme, we did pretty works all the way from the basin outpost, the hospital out through the Mount Vic tunnel and then out to the airport. So it covered a huge range. But the Golden Mile project actually only covers the central part of that project. So the Golden Miles and from Taranaki straight all the way down to Lambton Quay and then the background for Auckland light rail. Um, you already know that. So I'll just go over real quick that a solution for the CC a.m. corridor that has gone through many iterations. Basically just trying to improve congestion in the city by providing a transport solution from the city to the airport. We already talked through that. Cool. I'll pass that over to Peter. Let's carry on from problem analysis. Cheers. Right. So, uh, we want to just kind of, uh, recontextualize this, make sure that everyone's clear, uh, where we go next in terms of what we call the team project. And so, Mark been walking you through the steps, and we're going to, uh, go into a bit more detail in terms of how you actually go from the problem that will be putting out to you, which, again, is a wicked problem or really what you consider a set of wicked problems. Okay, we're a set of problems that grow out of a wicked, uh, situation. And so if you think back, those of you who had or or if you're a contract student that had something similar in another part of the university. Uh, when we go through this process, it is similar to this double diamonds process that we did in or , where we first looked at the problem. And then once we had defined the problem and, uh, I might just jump back here. Right. Uh, so Mark, Mark talked about this defining and analysing the problem, just like you did in the first diamond of or . Okay. And then identifying users and stakeholders. One of the key differences here is when you're dealing with a wicked problem, you have to put a bit more attention and weight on the stakeholders, because they do have these, uh, in some cases, widely conflicting, uh, requirements. Okay. So it's that, uh, similar process that we're going through when we, uh, give you these problems. These wicked problems are the first of which you'll be getting on Friday. Okay. So once you do that, you have to then, uh, kind of begin to, uh, I'll say, unpack this and to consider how you're going to, uh, go about first understanding the problem and then thinking about, uh, solutions. So this, first of all, root cause analysis. And again, this is something we introduced in or . What's called the five whys is really asking the question. We say five times okay. Actually I should use this example. Sometimes it takes three, sometimes it takes seven. But you want to keep peeling back to try to understand what's the root cause of what you're dealing with. Also in terms of the systems thinking methodologies that we've been talking about pretty much for the whole semester. And we talk about these things kind of in the abstract. It's like, okay, there's this thing called systems thinking. One of the tools in systems thinking is causal loops. Here's where you actually get a chance to use those. And remember that the systems thinking tools are not, um, are not, uh, algorithmic tools. Okay. So the causal loops is a way of looking at the problem and kind of, um, uh, visually identifying what are the relationships between various aspects of the problem. And so that's what you want to do once you actually get the problem brief. And again, your causal loops might look very different from another group because there's not a set approach to doing that. They're just a way of of understanding the problem and to be able to communicate it amongst your team. And uh, if you are working with external stakeholders, with them. Okay. The other thing that we talked about in terms of the systems thinking tool are where might the intervention points be? So as you work through this process, one of the other things you might want to consider is where are the places where you actually might be able to make a change. Those are what are called the intervention points. And if you look back to, uh, that material that I delivered a few weeks back, uh, the intervention points have

kind of a hierarchy to them in terms of where you can actually have the most impact. So again, that's something that you'll want to understand or begin to understand about your problem. Because when you look at solutions that might help you determine where and what you change in the system. And the next bit is trend mapping. So you want to look at this system over time. What's changed okay. If we think about the projects that are our students did last year around health care systems, some of those trends were around. What were the wait lists over a long period of time over, let's say, a decade? And how had those changed? Uh, we might also look at, uh, what were some of the disparities related to, um, Maori, uh, people trying to access the health care system? We might look at trends around, uh, the cost of certain things. So you want to identify which are the trends that you want to actually look at over a period of time. Okay. And then, uh, data to support insights into the problem. What other information can you research or can you pull out of the material that we provide to you? Because we give you heaps of references around the problem that we assign. And so how do you dig down into that to find something meaningful? And remember there are like , of you. So a big part of the challenge is for the leadership of the group to think about, how do we divide this up in a way that we can send people off to do their bit and then pull it back to be able to make sense of it? And then, uh, finally, multiple problem statements at the systems level. Okay. So when you think about in , uh, and you identified in that, uh, first diamond, you came down to one specific problem statement, what we called the how might we statement. Okay. And and then in this case, because this is a complex or, uh, wicked problem, you're going to have actually multiple problem statements. So you have to work through each of those. Okay. So it's just and you know, this picture just kind of captures what I just said. Uh, but it is bringing together all of this stuff the, the, um, diversity and complexity of these, these problems, uh, what you know and don't know about the situation and all the people who care and in, in many cases have really, uh, competing objectives, competing, uh, perspectives on the problem. So that's what you'll be doing in terms of tearing apart the situation that we give to you. Okay. And then as I mentioned, we're going to have multiple problem statements. And so in terms of decision making you have to actually consider how do each of those problem statements relate to the overall solution. And your team is actually going to come up with these weightings. And so so I just mentioned in the previous slide that some of these things have no algorithm to them okay. And in fact this this has no fixed algorithm to it either. But you're creating one. So you're trying to take something that is still inherently uncertain. But you're going to consider, uh, how much might one aspect of that wickedness, that wicked, uh, system, uh, relate to these specific problems? Because you're going to have to do that in order to apply, uh, the process to be able to. Come up with solutions and to compare them to each other. So you're going to actually come up with those weightings yourself. And again, what you come up with, even if your problems are similar, might be different from another team. Keep in mind also, you might come up with different problem statements than another team because you see the problem as being, uh, most related to a specific thing. Another team might view that differently. All good. Okay. There's no single right answer. And we emphasise this throughout the course. But just to put this out there again, there is no single right answer to these, uh, systems cases. In fact, we've seen wildly divergent approaches, uh, but still come up with with very good, uh, solutions. Okay. Uh, okay. And again, just like in or . You want to look at this? Uh, DFB, we kind of shorten this to the DFB framework. Okay. And I won't beat this too hard because you will. Last year, if you had me in or , you have heard me beat this hard. Okay? But we won't do that this year because we know you. You are all over this. And so when we think about desirability in the context of a complex systems problem, what

we're really looking at is desirability to a range of stakeholders. And so we look at for instance, uh, for patients in terms of the health care system, we're also going to look at Treasury. We're going to look at the cost of delivery nets. We're going to look at doctors and nurses and some of the stresses and impacts on them. We're going to look at perspectives of their the unions that represent them in terms of how much they're paid. So there's all these different people for whom we have to come up with a desirable solution, and some are going to be weighted more heavily than others. And and it's a, you know, it's a inexact and, um, iterative process to come up with that desirability. Then the viability is can we actually execute the solution or improvement that we come up with? And ultimately, can we pay for it? Okay. And so one of the goals of that is to be able to screen the options that are likely not possible. And so Marc mentioned this. First of all you have this brainstorm. And again this is like or . Once you've actually structured your problem you're going to actually brainstorm on all of the possibilities. And remember we talk about this divergent thinking. So you're going to come up with things that are solutions that are um, sometimes slightly wacky. Okay. Uh, I think in health care situation last year, uh, we did come up with some very feasible things where people have these, like mobile units going out to provide health care. Uh, but people were talking about, you know, like, um, pods being flown in and out, all kinds of stuff. Uh, and you want to get those ideas out there. So you're going to come up with this brainstorm. Or in some ways, you could think of this as the longer long list. Okay. It's the whole set of possibilities that your team is considering as, as anything remotely, uh, um, able to approach the problem. Okay. From that, you actually apply these filters to come down to what's actually worth considering further than what we call the long list. And from the long list. Then you start to apply, uh, these various criteria to get it down to as much referring the short list, the things that you actually want to flesh out and then, uh, be able to compare and cost against each other. Okay. So stakeholders and this is something Amanda is sort of our, um, I'll say stakeholder nerd. I don't know if this is recorded, so she'll hear me. Uh, but Amanda is, um, very, very detailed and, um, uh, spends a lot of time, uh, talking about stakeholders. And so when we talk about stakeholders, this just gives you a little bit of context and reminder about what we mean in terms of stakeholders. And so in a complex problem, what we want to be able to do is to think about, uh, categorising those stakeholders and, and their level of importance and the extent to which we want to manage them, uh, and need to be driven by them. So you'll have to consider that as well. Okay. So on the two projects or let's see, I guess just on the Golden Mile project that Mark just introduced, we've actually divided the stakeholders between what we're actually here, calling partners, okay. People who are actually part of the the project to be able to build this out, to be able to, um, get, uh, approvals to go forward and then the other key stakeholders. And so you're going to want to take a similar approach, is to be able to figure out which of the stakeholders are most important and the others that you still need to respond to, but are perhaps somewhat less important. Okay. And then once you've identified that, that's where you want to think about these stakeholder engagement plans, about which stakeholders are important. Best way to communicate with them. How informed or satisfied satisfied do they need to be. And to be specific. Because by being specific, it's going to allow you to do this. What we call is the iteration. You try different solutions and you're what you're really trying to do is to find the best fit across this whole range of, uh, situations that people would like to see. And ultimately, you're looking for that best fit. Okay. So this again is one from last year. And here is the power interest matrix. And we've actually placed or this this group did this is student work. Uh this group actually placed these uh stakeholders are in, in the matrix, which is something that we've, uh, gone over with you and given you some background on. Uh, so

they've actually laid out the stakeholders in a way that helps them to figure out who needs to be managed, how aggressively. Okay. And so, uh, remember also when we look at stakeholders, we're looking at the needs they have, the desires they have, the outcomes they want in terms of necessary. Nice to have or aspirational. And again this is student work. And and so they're actually identifying uh things that are necessary. What's going to be absolutely essential uh from the perspective of those stakeholders. And therefore something that the solution must provide. In other words, this is what's desirable to that particular stakeholder. So if we're looking at something that's necessary to a stakeholder that's going to be desirable. Okay. And we also, uh, introduced, uh, this, uh, let's see, week and a half or so, what we call the key success factor. So you're also here this referred to as critical success factors. And that terminology is pretty much interchangeable. So key success factors are critical success factors. And in the uh, exemplars, the examples from last year that will post uh, the most of the groups do use the term critical success factors. Okay. So those are the to most important requirements that, uh, you have for the project overall. Uh, and then uh, these should come from the necessary. So on that prior thing, it's uh, what's going to be necessary to people you want to synthesise from that these to most important. And then those are ultimately measured to KPIs. So what might the KPIs be? And actually, uh, one of the students who's here today asked me the other day because we were presenting things and some had KPIs and they didn't. And uh, this student asked, is that like, wow, is that required? Well, look at it that, um, the having KPIs identified is best practice. So that's what you're going to want to try to achieve is not only to think about what those might be, but how you could actually measure them and what might some of the targets be. And so you use all that ultimately to evaluate the options and narrow to a shortlist. So they brainstorm all the stuff that your team came up with. Long list the stuff that you, your team decided was worth investigating. Okay, a long list, um, to , ten to to , something like that. What do you reckon? Yeah, it's into ten. Yeah. I think you'll have you'll have a much longer list from your initial brainstorms that you'll then kind of, um, collect and screen to like an initial long list that would probably be somewhere from to . It's probably a good guidance. Yeah. Okay. So so then, uh, you have that and then you're narrowing to a short list. Short list, um, five ish mark at least two, but can be up to four. Um, really, if you're at the short list that you should not be able to differentiate which one is better purely for your requirements, you should have how many and maybe two, or maybe four of your best options that you can only differentiate between them by carrying out a full social cost benefit analysis. Okay. And so then you get to the long list options. And uh, this is an example for the City Rail link. And uh, so at that point they actually looked at four different approaches. And those are listed here. And ultimately the City Rail link was the one that was chosen. So they would have had to go through this same process and ultimately narrow it down, uh, to choose to go forward with the City Rail link. Uh. Let's see. Is this okay? I'm still on this one. Yeah. Okay, so, uh, four of them, as I mentioned. Uh, were these. And from that is what they narrowed down. And so you have to actually establish your long list options to be able to use what we call the key success factors to be able to align with the problem statements, to narrow that down. Okay. And here's an example. Again this is student work. Uh, by the way just a little bit of a plug for this. So we actually when you submit the final document, there's an opportunity for you to allow us to use your work in subsequent years as student examples. Okay. And you can see right here the value of this. Okay. Now by the way, if you choose not to do that we won't use it. And it's all good. It's not going to affect your mark. Everything will be fine. But uh, we have found most of the student groups in the last few years have allowed us to use this. And then, uh, that gives you an opportunity to see the

work they produced in us, to actually use it in something like this lecture. So here's an example of that where this group actually looked at their, their long list. Those are all the things that they looked at as possibilities. And then they looked at those key or critical success factors and also the desirability feasibility, uh, viability. And uh, from that, they were able to create this matrix to determine what to go forward with in terms of their short list. Okay. I'll pass it back to Mark, who will go over this example. Thanks, Peter. Um, yeah. Just wanted to compare kind of so you can see the differences between what we do in systems versus what we do in industry. So if I go back here, this is an example of two years ago where they were focussed on climate change adaption or mitigation. Um, so as you can see, all the kind of final options that they've rolled into their long list, and also the fact that when they were rolling out these final options in their short list, they had to define what geographic locations it was. These were made and all the sort of finer details that come as you go more granular, down and down, down the line. Okay. So remember, you go from that kind of, um, indicative business case, high granularity of detail. As you move towards the full implementation business case, you start to get more granular and granular, more detailed, more detailed. So really understanding what level that your analysis has to be at at quite this high level is going to be important. Yeah. I have a question. Once you have the whole place right. It comes from the different part of the state. Um. When you. What in the short list? Kind of like. So be friends, if that makes sense. Yeah. You can. Yeah. Someone different. Yeah, yeah. Awesome question. Yep. So the question was basically around how do you compare different options when you've got kind of different problem statements and you've got options that might only address, say, one problem statement or one of the critical success factors. And you'll find that as you come out and do these, um, do these analyses. And what you will do is that your role and I don't know if we have an example here. Uh, we might here here's a good example. So you'll roll it into packages. So what's common in infrastructure projects especially with Auckland light rail I don't know if I have that, but most infrastructure projects you'll roll it into a do nothing uh do minimum uh, do medium and then a do the most. And that's how they'll roll that into there. So you can think about rolling if you've got different key success factors in different problem statements. Sure. Your long list options here might one of these options might not meet all of those critical success factors, but you can think about rolling different options into a final package that meets those critical success factors or those problem statements, uh, the most or at least the medium or, um, if you don't have much money or there's not much funding in the space for this or the problem's not that impactful, maybe it's a do minimum option. So I hope that answers the question there. Thinking about and it's a really good question, thinking about rolling those options into a form of package that solves the most of those critical success factors. Thanks. Thanks for that. Well good point. Cool. So that's what, um, was done in systems then jumping forward for the Golden Mile. So when I looked at the Golden Mile. Yeah, just like you can see there, they've got to do minimum and then a bunch of different options based on um, various critical success factors, parts that make different problem statements, all that sort of stuff. And then up to them to decide one, what's the framework for which they're going to carry out this multi-criteria analysis? I think this one was a seven point, yes. Seven point, um, analysis. Up to you. You can use seven point. You can use, um, three point. So high, medium, low you could use weighted scoring to . Up to you. Again the point is to analyse and white the scoring against the different options to try and figure out which option or combination of options will give you the greatest value. So as you can see the quite what is done in systems. What is done team project does actually follow what gets done in industry. Cool. So, uh, once you get to your shortlist options, you'll have to do that

economic analysis, that social analysis to really determine what is the best way forward. The minimum might be the best way forward. If the impact of spending that much money, um, isn't worth the benefits that it creates. So in that case, you might need to do something more than that. Do nothing. You might do the do minimum. A lot of the times to do maximum is seldom done because it's substantially more in terms of costs for not much more marginal benefit. So maybe instead of a BCR of benefit cost ratio of, you know, ., you get a benefit cost ratio of .. Um, in that case that might not be worth, um, carrying out. That option. So with a small number. I've already talked about this a little bit. With a smaller number of options, you're able to carry out a more detailed analysis. So you'll do a social cost benefit analysis using the kVA to monetise those biggest impacts, using the cost benefit analysis framework to carry out that economic assessment, compare those monetise impacts with the cost some revenues produced from the project, as well as carrying out a multi-criteria analysis for the more uh, non monetised uh impacts. Important important important. Always explain those assumptions. Then you'll carry out that social impact qualitative analysis using that MCA. Talking about the impacts, discussing the impacts, especially on those four capitals. You'll also want to identify which domain of well-being your your solutions or your problems affect. And then talk about that as well. We've already covered a little bit of that both last week in this lecture as well as the social CBA. Then when carrying out these assessments, you'll summarise these in a nice easy to read table with the full analysis put into the appendix. Just again, a comparison of the differences between systems in an industry Golden mile use benefit cost ratio. Rates of return. Net benefits. Present. Net benefits. Um, and similarly when we talk about over here benefits cost benefit ratio costs what are those monetary costs. What are those monetary benefits. And what is any other qualitative or quantitative impacts that we should take into account? Full analysis in the appendix. When you determine your preferred way forward, you use that social cost benefit analysis. What creates the most value? You must logically explain the rationale for your decision. Consider how this plan would fit into a wider program. So when we think about governments, you have governmental plans, strategic plans. Then you have programs that are created by vendors to meet those plans. And then you have tenders for smaller projects within each of those programs. You must decide and determine how well your solutions will fit in to those wider strategic plans. Really important. It will always be done in the industry. Um. Yeah. Consider how that fits into those long term strategies. And I've got an example coming up. But for example Golden Mile. Well then let's get Lance and moving. Project option three was endorsed by LG and Alguém and publicly announced as a preferred investment option for the Golden Mile project. So I'll talk a little bit about where the Golden Mile project is now. It's not really running anymore, unfortunately, but, um, we'll talk about that in a second. There's no that. The significant benefits are expected to be generated by the combined pedestrian travel time crash reduction and pedestrian realm benefit. So those are those three key monetary impacts that they were able to monetise using the CBA spreadsheet. So expectation in the same project is for you to analyse monetise at least one impact in the systems week. You'll look at probably how many more, or what are the most primary or key impacts that you'll need to monetise. So this is how, uh, Golden Mile, uh, justified their alignment to various strategic plans. You've got governmental policy statements. You've got ten year plans from local council. You got ten year plans from regional council, your NZ Transport plan. So many, many, many plans, many strategies, many, um, many budgets that they need to be aligned with. Otherwise they're not going to get the funding. So consider those plans. Consider what plans within your wider projects and how your options will align with those plans. Once you've done that, got your preferred

way forward, you've explained your preferred way forward, how much it's going to cost, what impacts, what benefits it's going to create. You can jump into project scoping, project management. How is this rollout going to look. Um, so this and for three don't look at specific Gantt chart or schedules because these are very high level projects. That sort of level of detail won't come until far past the implementation case. So just looking at both a high level timeline and a way of measuring those, um, how are you going to measure those successes? So you'll have maybe you'll have some milestones, deliverables put onto that high level timeline, but not looking at a full Gantt chart and schedule for this one. Okay. How will the rollout work? Some projects might be short term and some. Sorry. If you have your final projects or your final, um, plans packages, some of those options in that package are going to be more shorter term. Some of those things in that package are going to be more longer term. Some are going to be somewhere in the middle. So you really need to consider how are you going to roll out the different parts of your packages, the different options and your packages in a way that makes sense? Okay. So last thing to finish off today. Just going to touch a little bit on kind of project realities project cancellations. Sometimes projects don't always go to completion. We see this quite a lot. These projects are really expensive. If there's Project Blow-outs that you know, at two, three, four x the original stated price, then you might say, okay, maybe the decision makers don't want to burden the taxpayer with those extra costs. So they might get cancelled. Projects can be cancelled for a variety of reasons political decisions, but mainly project Blow-outs projects going over budget. There are also times where the public perception very rarely, but sometimes public perception can play a big role in projects being carried forward. And often when projects get cancelled, there is a little bit of backlash or a lot of backlash in some cases from the public on various things. Um, the Cook Strait ferry replacement, for example, that was recently canned. But the reason being the project has blown out a lot from projected when the business case was submitted to the government in . Now in , last year in , blowing out to . billion. And then, as you would have heard, Nicola Willis cancelled that. We're going to use that maybe for tax cuts or some other, um, political decisions up to them to make those decisions go to mile. Uh, that's paused at the moment, but the Let's Get Wellington moving program has actually been dissolved recently since National came in. Can that project. Um, again, a little bit of blow out and project costs and there was some public perception backlash as well against the original Let's get Wellington Moving program. Auckland Light Rail discontinued again due to large cost blow-outs again. So this does happen. And I think what's important to understand is that this is the reason that you do your sensitivity analysis, the reason that you do your testing, you test against the worst and the best case scenarios, because assumptions don't always hold true. There are many reasons that the project may go overbudget. Underestimating the project scope or, uh, scope creep here changes to the designs that were different to what they originally proposed. Unforeseen events. Gabriel. Covid. These all add to increasing costs. Very, um, very relevant for the City Rail link, which is, um, gone quite a bit over the budget since then, has had to ask the public for more money to fund this. So . billion. that's increased to . billion. They have to try and get that money from somewhere. They need to resubmit a business case to try and ask the government for more money. Assumptions they don't always hold. Hence the reason for that sensitivity analysis for that testing. Cost increases. So specifically for City Rail. Those cost increases because of Covid. That meant that I had to ask for more money. And scope creep as an example here, where instead of having the original carriages, they wanted bigger carriages. Scope creep, the scope crept out, the cost increased for those bigger carriages and therefore they need to ask for more money. So

project Blow-outs do happen. Um, it's not up to us to decide whether the project continues forward. That's up to the decision makers. All we can do is provide the latest evidence with the latest tests, with the latest assumptions, and put that forward to the decision makers. The take home message being business cases follow a system method, but they are risky. And in reality you cannot always, um, plan for that uncertainty. But you need to try your best. You need to run those sensitivity analysis. You need to do those sensitivity tests to understand what's the worst case scenario and what's the best. So I'll leave that to you. Thank you very much. I'll see you again.

Lecture 14

Okay, cool. Uh, yeah. So today we are going to take a look at the research and resources. Um, yesterday, Mark and Peter went through the different stages of business case and reviewed the business case in stages. So today we are going to look at the research and resources to see, okay, for example, how research can help us with different stages of the business case and what resources are available to help us with coming up with some evidence based, um, arguments. Okay. Um, so learning outcomes. Um, so we are going to look at, uh, systems research. And how is it different from the scholarly research that you're doing in your part for projects? Um, describing the system research, uh, steps and uh, principles and then identifying the different sources of information and also applying the, this, uh, research principles that we learned in your team projects, which is coming next week, and also the systems project, which is in week nine. Um, yeah. So I'm going to first take a look at the systems research. Um, and what is it? How does it help us and how is it compared with, uh, scholarly research? Then, uh, we are going to take a quick look at the significance of the systems research. Um, when you're developing ideas, when looking at the various aspects of the wicked problem, and then some tools that can help us to visualise and, you know, organise your thoughts about, um, a topic and then the key resources that are available, especially the government reports that you probably haven't, um, had any experience with so far. And also some examples. Okay. Uh, all right. So yeah. So in engine four three, the scope of the business cases are just business to government projects. So this actually entails some, uh, megaprojects or big projects that that you are actually providing some recommendation in order to tackle a wicked problem at a government level. And so these big cat problems, you have actually learned it from previous lectures that are, uh, there are different, um, sort of elements inside it. And then they are quite interconnected. They lack clear boundaries. And, uh, it's actually quite difficult and very complex to, um, uh, define it like you have to come up with some, like at least several problem statements. And also, uh, they don't have to seem like a very, um, easy solution to you. So it looks like, uh, at an intertwined, um, thread that you can see over in this picture. And then when you try to, uh, entangle, uh, one of the threads of the problem, other, uh, um, other problems, uh, or new problems keep popping up. And so therefore it's very hard to define and also define a lot hard to solve. So how does research can actually help us uncover these, uh, interconnected elements to be able to better analyse the problem from various perspectives, such as, for example, social, economic and, and, um, you know, cultural and, and environmental aspects. Um, so this is where, uh, the system, uh, the systems research and research come into play. So it's a systematic approach to collect the data, to analyse the information in order to, to serve, um, uh, some purposes, such as, for example, uncovering the interconnection, interconnected aspects of the wicked problem, uh, also looking at the stakeholders and also understanding and identifying the stakeholders

and what are their requirements and if there is any conflicting requirements, how we can actually going to manage and um, uh, engage with our stakeholders, because this is a very important part of a project. And also when it comes to the, uh, finding a solution or recommendation for the, for the problem, um, what are the, um, uh, existing or potential solutions? We can actually explore them through research and then ultimately, um, we can actually come up with some, uh, looking at the cost and benefits of the, uh, the solutions and then finally make a decision about our preferred way forward. Um, so we want to actually, um, do this, um, in order to ultimately arrive at an informed recommendation. Um, so we need to actually gather the evidence for our arguments for our analysis. And so this is how we can actually help. And so this is research can help us. This is how research can help us. Um, yeah. So. Like I said, it's better on. So research helps with a better understanding of the wicked problem. It can actually provide some background and some context for the problem. So you can look at it from different angles. And through research and finding information from various resources, you can actually gain some insight into some underlying causes. It's very difficult to find all of the underlying causes of a wicked problem. And then when you do this, um, team project speak and also system project, you actually understand that it's very complex, complex, and you need to spend more time on it. But you can actually through research, you can come up with some of the underlying causes of the wicked problem. Um, it actually promotes systems thinking. So by system thinking they mean that if you change one variable within the system, how does the, um, the system behaves and reacts to that change? So any sort of intervention that you actually propose to, um, to actually tackle the wicked problem might actually affect other aspects because of this, these interdependence and interconnectivity of the elements. And it actually helps us to map out the system, to take a look at all the various variables and the components of the system. Um, and, um, it actually helps us to identify the stakeholders. So this is very important parts, like I said, because with your team project and your system project, you don't have have a chance to meet with different or various stakeholders to talk to them, to understand their viewpoints and also their requirements. So through research, you can actually gain some understanding of the requirements of the stakeholders in order to better or develop your engagement strategies and better manage their conflicting requirements. Um, and also, during developing the recommendations, you can actually look at various perspectives, um, and explore alternative approaches. And also what are their impacts. And then when you want to, you know, find out whether it's a traditional financial CBA or the social CBA, you want to actually, um, uh, support your analysis by some, uh, supporting materials from the research. So this is how the, um, uh, research can actually help us with the CBA in terms of, uh, estimating the cost and then also finding out the potential benefits that you can actually, um, create with your, um, solution. Um, so, yeah. So this is just a, um, comparison between the scholarly research and the systems research. You are already familiar with the scholarly research. That's what you're doing as part of your final year, uh, research project. So you're probably going to have you have already developed a hypothesis, and you are going to test that hypothesis, um, in your research, um, by going to the lab, doing some lab work or maybe some modelling, and then some of the scholarly research is actually hypothesis oriented, whereas the systems research is forecast oriented. So you're, um, not looking at the past information, but you are actually want to understand what is the effect or what is the, um, the trend, um, over the next coming, like let's say ten, years. So you need to actually understand what are the trends and also what is the forecast of projections over a period of time, um, which is actually into the future. Um, and then uh, there are some other differences, such as, for example, the methods, the resources that you

need. So for the, um, scholarly research, you usually, often, uh, tend to actually look at the published literature, which actually, um, looked at the past studies or something like, uh, um, past research. Whereas for the systems research, you looked at both the published researcher from the past, um, uh, research and also some of the projections, um, and also future trends. And also you can see there are some other differences in terms of the audience, in terms of how you, um, use your, um, research outcomes and how your, um, how you can actually use it, for example, for the business case and so on. Um, yeah. So some tools that might be very useful, especially when you get started with looking at the project at the, uh, the problem, uh, spaces. Uh, and also for your team projects. So the first tool that we are going to take a look today is just this, uh, cluster maps or it also called, uh, brain dump map. Um, so this is a very useful collaborative tool that you can actually try with your team-mates in your team when you go through the the project brief. But it's a team project brief for the system brief. Um, you actually often introduced to the project, uh, background or the problem background. And so you can actually start, uh, by collaborating with your team-mates by, um, probably just using a big piece of paper and different markers with like, two different colours and start to, uh, generate ideas. And also from your research, you can actually, uh, find out some information and then, um, add them to their paper. So you can actually just use, uh, uh, the centre of the paper and just write down your topic. And then everybody within the team can actually just, uh, contribute to the thinking and ideas by actually adding some more, uh, concepts or some relevant materials to the topic. And then once you actually come up with these, um, sort of, uh, uh, scribble on your paper, you can actually try to connect them by drawing, um, uh, uh, connection between them to develop a complex view of the system. So the, the purpose is to mine all the components that make up the system. And then the key part is to draw the connection between them to develop a complex view of the system. So when you actually going to when you are going to write about the problem background, this picture can actually help you tell the story by looking at various angles and also various, um, elements that are actually contributing to the problem, to the wicked problem. Um, keep in mind that these relationships are messy and this is a natural part of a wicked problem. Um, so don't be afraid that if you find out it's very complex, it's very hard to explain, because that's part of the nature of the wicked problem. Okay. Um. And then from here you can actually come up with some key areas or key components of the system that you want to go further, and then maybe develop your solution based on. So this is important to highlight those, um, key aspects of the or key components of the system. The other one is the interconnected circle maps that you can see a picture over here and here. So this is also, um, actually it's from a refined area that you identified through a cluster map. And it actually allows, uh, deep exploration of the relationships. So you can actually just take some of those, um, uh, key components and then just move them around. So maybe you can just, um, cut, cut the paper and then, uh, move around a circle and then try to also, um, uh, draw the connection between these elements. So like nodes and then connections. And um, therefore you can actually find out more about the non-linearity and the cause and effect relationship and also how changing or intervening your intervention might affect different aspects of the, the the system. Um, you also can use, um, mind mapping tools. It's also a great way of visualisation of your ideas, um, around the, the different aspects of the problem and also different, um, um, different elements and the interconnection between the, the elements of the system. So here you can see just a using a mind map in the agricultural system. There are also other examples that you can take a look. Um, it actually helps us seeing the, the elements in a relational way, um, which uh, rather than a linear way. So sometimes if people use a really linear cause and effect

relationship, they might actually miss some of the aspects. So it's actually help us to see in a relational way. Um, it's a very good way to visualise the, uh, your concepts and your ideas. Um, there's also another method called Rich picture. This was actually, um, it's a cartoon, like, um, um, explanation of a situation. For example, here you can see, um, um, about the the effect of the, um. So the rich picture is actually a combination of text. Um, you know, icons, pictures and symbols. And it actually helps you to better understand the situation. So it actually creates a shared understanding of a situation, and then you want to explain it visually. So this is also a very good tool to take a look at different components of the system, the interconnection and interdependence of different components of a system. And so this is also a very good tool. Um, you've heard about the causal loops from uh, Peter's lectures, I think. So this is also a way to understand, uh, that, uh, actually the, the variables within a complex system. And what are the, uh, cause and effect relationship within, uh, variables within the system. So this is also another design thinking tools. And these design thinking tools are really, um, useful when you want to generate and structure your thoughts. And then, uh, yeah, a stakeholder mapping, which you are familiar with. So just the power interest matrix and how you can actually identify and map the stakeholders on the power interest matrix. Uh, so you can also classify them into the primary and secondary stakeholders as well. So remember that these design thinking tools are useful in conceptualising and also visualising your research. Um, so now we are going to take a look at some of the sources of information, which is actually quite helpful for your business case for your project. Um, so we are looking at this, these resources, government reports, statistics and also the annual reports from the industry. Uh, there's also some you can find some, um, relevant materials from the news on articles. And I actually have listed them as a, as additional resource on canvas. So you can actually take a look at the, uh, canvas page for this lecture to find out, for example, a list of the, um, like business magazines in New Zealand as well. Um, so then when it comes to the team project or the system project, you are going to have this section of, uh, uh, dedicated to the supporting materials. So some resources will be provided to help your team get started with the project. It's a good starting point for, um, uh, reading through some background of the project. Um, and also the issues, um, several issues around the problem. Uh, and also maybe some, um, how other countries reacted to such a problem. Um, and also, what are the potential solutions that might actually, uh, come to your mind, actually. Um, so this is actually provided mainly due to the time constraints, because you don't have a, uh, a lot of time to spend on this project. And if you have a time limit. So you are going to have some supporting materials. It's a good starting point to start with your project. And then, um, but in real world projects you must find most of the data yourself. Um, and you need to be able to analyse the information yourself. So my recommendation to you is don't limit yourselves to just the supporting materials and explore the various resources that are out. Some of them I have actually show you in this lecture. Um, so some of the uh, resources that are publicly available are from, uh, Statistics New Zealand. So you'll probably have this, uh, before you probably have referred to the Statistics New Zealand before for obtaining some, uh, data from, for example, for other courses. Uh, so Statistics New Zealand provides some uh, uh, statistics data for which is actually publicly available and you can actually use. Um, and then there are government reports, um, such as for example, those publications from Treasury in New Zealand. Um, so if you click here, you can actually go to this um, publication page and actually take a look at some of the resources available. You can also find various sources of information from the government reports. For example, if you're just wondering about the stakeholders, how the government is engaging with different stakeholders, you can also refer to the government

reports. Some of the government reports are from different, uh, ministries or agencies that, uh, for example, Ministry for environment or um, other ministries like the Health Ministry for health. Um, and so you can actually, uh, find out a lot of information from these reports, um, such as the discussions such as the trends, um, any, um, any data regarding the transition to a new system and so on. Um, so I recommend this one as well. And then we have the government portals and then annual reports from the industry. So um, here is one example. So um, there is a wellbeing indicator portal under the Statistics New Zealand that you can actually refer to by clicking here. So it actually provides uh like behind the statistics New Zealand looked at the wellbeing and then um actually measured and uh track the progress of the wellbeing uh aspects from different indicators. Um, so these measures cover New Zealand's current wellbeing and also the future wellbeing and also the impact that New Zealand is having on the rest of the world. Um, so let's say if you go to this current wellbeing, you can see that it has a different, uh, sort of classifications. So let's say you have one to find out. For example, what is the let's say you're, you're thinking about the cost of living crisis. And then you want to find out some information about the cost of living crisis. So you go to the economic a standard of living. And then let's say I choose the low income. So you can have this bar graph showing how the people living in low income households change over time. So you can see that maybe over the few past few years it has dropped, um, slightly. But then since the, uh, , , it increases a bit. Um, so that might actually increase. Um, just give you some information and insight. So for example here you can say that maybe, um, this, um, reduction in the people, low income people and or percentage of the low income people might attribute to, uh, better employment or, um, better economic growth of the country. And then eventually due to the inflation, due to some sort of other factors, that the number of low income people starts to build up, maybe some employment, recent unemployment rates, and that is that, um, has risen. Um, so yeah. So you can actually gain a lot of information from the Statistics New Zealand Wellbeing indicators. This is a, um, this is something that I recommend you going through and explore yourself. Um, if you're looking for other, uh, sort of, uh, reports from the government. So. Wellbeing reports. This is actually published by the Treasury every four years. And so they have different, uh, actually shows you how the wellbeing of the country has actually progressed over the past four years. Um, so you can, um, uh, go through this report, understand some of the indicators how this New Zealand doing. How's the wellbeing of the nation? Uh, has actually, uh, evolved over the past few years. And there are also some other background papers that is that are listed here. So this is also a good source of information when you want to look at the wellbeing aspect. So this is actually when you're looking at the non-economic factors and maybe how your potential solution might actually contribute to those non-economic factors. So you can actually use this as a resource. Use this uh, wellbeing report as a resource to, um, see how your options aligns with, uh, those indicators and those, um, um, wellbeing measures that are in place. Um, so Treasury has also some other publications, financial statements, which I actually, uh, published, uh, to the public every month and also annually. Um, so it actually gives you some, uh, high level and also, um, uh, like holistic information about how our economy is doing. What is the total revenue of the government? What is the total expenses? Um, and also some assets and, um, the level of assets and liabilities of the government. So it gives you a lot of, uh, financial information. And also we have this long term fiscal position, which is actually like a projection into the next years in New Zealand. So you can actually understand, for example, if you make it this, this is actually a very good, um, resource for the decision makers, because they can actually understand if they change a policy or if they, um, make an intervention into one of these

problems that they are actually facing. Um, how does it affect the long term position of the, the financial position of the country, um, the next years and so on? Um, there are also the government portals, um, which actually provides background on the current system. So if you want to learn about the current situation of, um, like one area or one topic, let's say health, you can actually go to through the, for example, the Health New Zealand um, portal and understand what is how the current system works and also, um, how the, how the transforming of the health system work. And there are also a publication sector that you can actually have a look at to understand more about the, um, the transformation and also what it means. There are also, um, some other government resources. If you are just wondering about how you are going to, uh, estimate the cost for, um, for any option, there's uh, CVA tool which has been, um, presented to you in the previous lectures by Mark. So you can actually use this a spreadsheet model. There are also NZ costing tools. Um, uh, which you can actually refer to these tools that are available for you to, to explore. Um eight uh Auckland transport costing estimation. So these are some of the um tools that are actually available for infrastructure projects and so on. So you can actually look at them. And then maybe for the, um, for the health sector, this uh, Health New Zealand cost estimation guidelines is also very important and very useful. You can just refer to the appendix of this, um, um, reports to understand how they actually estimate the cost for the health sector. Um, so as recommended, uh, previously by Mark in the previous lectures, always use a bottom up approach because you can actually break down the, the big project into the smaller component and the smaller parts, and then estimate the cost from the, uh, for, for each component in order to be able to estimate the cost for the whole project. Okay. So it's it's a good idea and I recommend it to use a bottom up approach. Um, another thing is that the annual reports from the industry. So this is also publicly available. So you can just Google, for example, if you're just wondering about, let's say uh, dairy industry, for example, you can just Google and then you can find uh, some information for one of the big players in the dairy industry, like the Fonterra. Uh, since they are publicly listed, they have to, um, make all of the financial performance and all of the, uh, results available to the public. Um, so you can actually go to the different sections of this, and this is annual leave, so you can just track, um, how the industry performs over the years and also some, maybe some projections as well. Uh, so here you can also get a lot of information, for example, if you're just wondering about, um, the cost of food and how it's affected throughout the years. You can take a look at the the reports from the suppliers, like the, the manufacturing after food and see, for example, let's say in this case, I found out the cost of collecting milk has increased over the years. So that might actually contribute to the cost, um, increased cost of uh, food, let's say in this case milk. Um, and then you can also see some commentary like for example, uh, what actually drives this, um, increase in the food price, for example, high inflammation, high inflation and also significant weather events have been mentioned as the some underlying causes for increased, um, price of the food. Um, and so this is very good and gives you some information. Um, but keep in mind that some of these um, companies are not publicly listed. And so if you want to gain a big picture of the whole industry, you can actually just look at the annual reports. You need some other comprehensive resources that actually looked at different various, um, aspects of the, um, industry and then, um, give you a more comprehensive and holistic picture. And that is through the, um, subscription based databases that are available through library. Um, so here are some of those, um, uh, resources and databases. Um, um, you can also use this, um, this resource to explore how you can actually refine your research, how you can actually, um, use this, uh, database searching more effectively in order to get a better results. Um, and also there are also

some, uh, library tutorial videos that are linked to the canvas page that you can actually take a look and understand from there in order to, um, so there are more explanation about each of these databases and why they are useful. Yeah. So if you go to the to the library website, you can go to the databases section. And here you can have uh, browse databases by title, by category and also by subject. It's actually quite good that we have um, dedicated databases for engineering. So if if you're just wondering about this, um, whether your field of study or your, um, your research in any of the other courses, you can actually refer to these databases and gain some information from this research. Um, so the other and so here is just an example of using the library databases. So um, if you remember I just mentioned about the dairy industries. So here I went to this database. I just work and just search for the, um, dairy farming or dairy industries in New Zealand. And this is a report that I can actually find out cheese, butter and milk powder manufacturing in New Zealand. And I also can download that as a PDF file. Um, so it can give you a lot of information which can actually helps us, um, build a big picture because we are not just looking at one company or one industry in the, um, dairy industries in New Zealand. But we're looking at the whole picture. Um, and so we can find out a lot of information such as the total revenue, the number of employees, you know, uh, and also some other information, like, for example, key external drivers into the, uh, growth of this industry, the major players and so on. And this piece of information is actually quite useful. So it actually shows us, for example, the areas in the country that this, uh, dairy industry business is concentrated in. So let's say, uh, you are a decision maker and you want to develop some strategies for climate change mitigation. So let's say you want to reduce the emissions. And so you understand that different areas has different requirements. So um you can see that from this picture that white cattle is has has the highest concentration of the dairy and dairy industries followed by Auckland and then Canterbury. So when you want to develop some strategies, do you understand that these regions have different requirements. So they uh so you can say that once you can propose a solution that fits for all of the regions. So you need to actually develop some strategies to focus more on the regional rather than the country. So you need to actually think about these uh, factors as well. And this is how you can actually analyse the the problem more effectively by looking at those insights from the, um, reports that are available through the database. Yeah. The other one is this market data, uh market lion. So it actually provides a market data. So what I did, I went to these uh, sections, um, so sector reports and then consumer goods and then find out these three, um, uh, reports dairy in New Zealand. So you can see that is also published quite recently. And this is one of the key points and key strengths of these, um, databases that they have um, this sort of analysis and very updated and up to date analysis for and different facts. Um, again, you can actually find out some other information, like for example, the market share of the uh, dairy industry in New Zealand and also how it actually performs over the years. There might be some also some projections as well. So it it gives us a lot of information and insights which can be helpful for building our arguments for, um, when it comes to developing solutions. And so. Yeah. And then, um, so once you you've done your research, you might come up with a lot of information. I'll find like qualitative data and information. And then you need to actually piece them together to build up a big picture by analysing the information from several resources. It's really important. And not just looking at one sources of information, but looking at several sources of information. And um, you might want to take a look at this situation from various angles in terms of presentation into your report, your, uh, team project report assistant, project report. Uh, please remember this, that these projects give you an opportunity to demonstrate your critical thinking and also problem solving skills. So by just

presenting the the data without any interpretation and without any analysis, you don't actually show your critical thinking and analysis and problem solving skills. It's really important to spend time to analyse and look at, um, various looks at the problem and also the solution from various angles, and then, um, try to analyse it in a way that is more sensible and also supported by the information from reliable resources. Um, and then another way to communicate your findings in a more digestible format is using visualisations. So if you could go back and take a look at some of those, um, um, exemplars from previous years, you can see that, um, people actually used, um, charts, graphs and diagrams in order to summarise their findings and also, um, that use it. I like using infographics in order to better communicate complex data, because it actually, um, makes more sense to come up with this sort of visualisation to also, um, uh, talk about these different factors rather than just numbers. So you can I, I actually, uh, encourage you to use these sort of visualisations in your reports to make it more streamlined and also easier to, um, comment cases is a better way to communicate your, uh, findings and also build your discussions. Um, you can also use these, um, infographics to illustrate the implementation plan. So once you come up with your recommendation, the next stage is to come up with the implementation plan. And also here you can see an example of how people, uh, how, um, the timeline has been provided. And then key stages of the implementation has been provided as well. So it's a better way. Um, to just summarise, uh, the implementation as well. Um, and then it's a better communication way. Um, and then just one last thing for the referencing. So if you're using other people's writing ideas, you, um, you need to actually cite them properly. Um, it's actually easy to cite books or journal articles or let's say, government reports in your, um, final report, but it's actually quite hard if you find a, um, let's say, a post on social media from a news agency or, um, uh, government that, uh, ministry. So how do you, uh, how do you cite that? What is the template for citing that? And so if you go to this QuickSight tool, you can actually find out what is the reference type that you want to use, for example, social media. And then you have the format here. And then there's examples. So you can actually use this in order to uh format your references as well. So that's a very um, useful tool that you can actually use for your referencing part of your report. And just before we go, just some take home messages. Uh, so explore the key resources such as the statistics, um, government data, industry reports and also those databases that are available on the through the library website because they provide comprehensive and also valid information. And remember to also communicate your analysis effectively by using tables and visualisations and infographics. Um, is there any questions? Okay, so I just want to show you one thing before we go. Um, so if you go down here, you there's a quiz that you can actually try after the lecture. And then there are also some additional resources that you can actually use. Um, for example, there's um government reports for Ministry for Environment and Ministry of Health and so on. So please spend some time to go through these, uh, additional resources and those, um, those, uh, recordings from the university library also listed here. So you can also go through and understand about those databases as well. And then the last announcement is just that, um, quiz two is coming this Thursday. Um, so the lecture nine to lecture will be, um, um, in the quiz two. Okay. Thanks so much. And have a good day. Thank you.