Belgisch Instituut voor
postdiensten en telecommunicatie

Mededeling van de Raad van het BIPT van 4 mei 2022 betreffende de algemene studie over de implementatie van 5G in het buitenland

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INHOUDSOPGAVE

1. Inleiding

1. De uitrol van 5G en dus ook de toepassingen van deze technologie hebben in België enige achterstand opgelopen tegenover de meeste andere landen van de EU en de rest van de wereld, waar de uitrol van 5G al sinds 2018 begonnen is. De langverwachte veiling van het toekomstig 5G radiospectrum wordt in ons land voorzien voor juni 2022. De 5G technologie is onontbeerlijk om ervoor te zorgen dat consumenten en bedrijven kunnen profiteren van de digitalisering in alle industriële sectoren. Om een snelle adoptie van de 5G technologie te ondersteunen heeft het BIPT door Capgemini Invent een studie laten uitvoeren die een overzicht biedt van geslaagde 5G-initiatieven in het buitenland, om als inspiratie te dienen voor de Belgische markt.

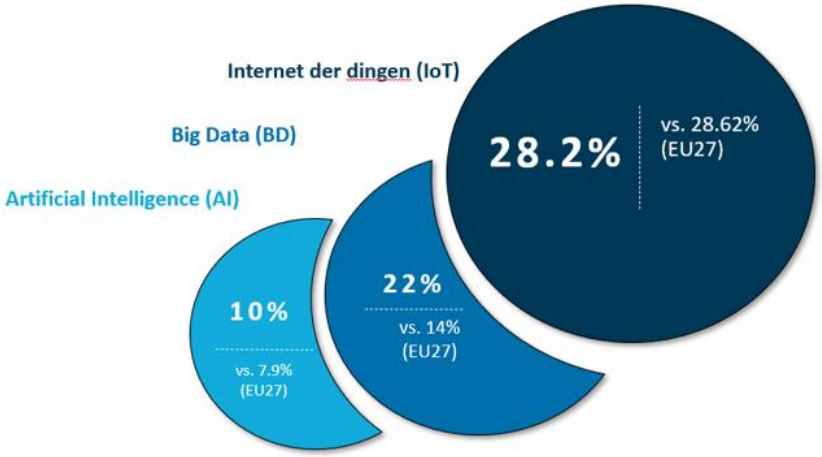
2. Teneinde die praktijkgevallen te selecteren die voor de Belgische markt belangrijk zijn, werden een aantal evaluatiecriteria gehanteerd. Deze criteria werden gesteld met het doel enkel use cases te selecteren die de adoptie van 5G in België zouden kunnen versnellen op een duurzame en economisch efficiënte manier. De bedoeling van deze studie is namelijk eerst en vooral de Belgische markt te informeren en te sensibiliseren in verband met 5G.

3. Anderzijds illustreert de studie dat de Belgische achterstand op vlak van 5G hoogstwaarschijnlijk een tijdelijk fenomeen is. De Belgische economie positioneert zich op vlak van digitalisering immers minstens even innoverend als de andere leden van de EU. De aanwezigheid van en knowhow gelinkt aan al deze technologieën zullen elkaar ondersteunen en de effecten van de implementatie van 5G-toepassingen op de economie en de samenleving versterken. Ons land is hiermee klaar voor de omarming van 5G-toepassingen, waarbij 5G als een belangrijke 'enabler' dient te worden beschouwd die voordelen zal opleveren voor de hele samenleving en economie.

2. Samenvatting

4. Uit de studie bleek dat er reeds een groot en verscheiden aantal 5G-toepassingen te vinden zijn in het buitenland. Hierbij werd niet alleen gekeken naar de Europese context, maar ook naar verder gelegen landen die al een tijdje met 5G-toepassingen aan de slag gaan, zoals bijvoorbeeld China en de Verenigde Staten. De studie focust zich op het buitenland en neemt daarom Belgische praktijkgevallen ('use cases'), die weliswaar ook voorhanden zijn, niet in beschouwing.

5. De uitrol van 5G en dus ook de toepassingen van de technologie hebben in België achterstand opgelopen tegenover het buitenland. 5G is echter in België een even beloftevolle technologie als elders. Uit de studie blijkt namelijk dat België geen zulke achterstand (en vaak zelfs een voorsprong) heeft op de andere Europese landen wanneer gekeken wordt naar het aandeel ondernemingen die reeds het 'internet der dingen', big data[1] en edge computing[2] toepassen. 5G is een technologie die in samenspel met deze andere technologieën nog meer potentieel biedt. De Belgische ondernemingen zouden, gezien hun huidige gebruik van moderne technologieën, dus een vlotte en snelle adoptie van 5G kunnen kennen.



Figuur 1: technologische adoptie in België tegenover de rest van de EU27.

6. Om een representatieve, relevante en diverse verzameling use cases op te stellen, werden bij de selectie meerdere filters gehanteerd. Zo werden enkel use cases geselecteerd uit sectoren die potentieel toonden sterk geïmpacteerd te worden door de implementatie van 5G. Een bijkomend criterium was dat de geselecteerde use cases aansluiting moesten vinden bij een sector vallende onder de federale bevoegdheid.

[1] Big data staat voor het verzamelen, verwerken en verbinden van een grote hoeveelheid gegevens uit diverse bronnen.

[2] Bij edge computing worden de data, geproduceerd door de IoT-apparaten, verwerkt door het apparaat zelf, of op een ander apparaat in de nabije omgeving. De data worden aan de rand van het netwerk verwerkt, en niet door een centraal verwerkingssysteem, vandaar de naam edge computing.

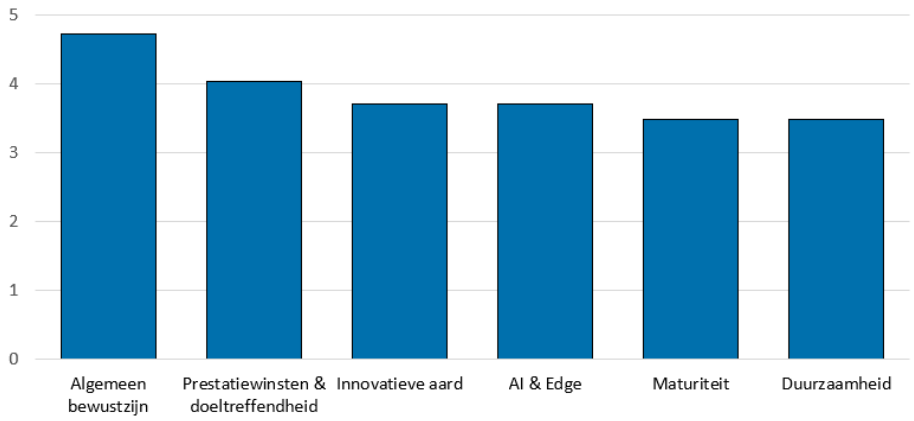
7. Uiteindelijk werden acht sectoren in beschouwing genomen: transport & logistiek, productie, 'smart cities', energie & nutsvoorzieningen, gezondheidszorg & biowetenschappen, defensie & openbare veiligheid, cultuur en overheidsadministratie.

8. Daarnaast werden ook enkel projecten geselecteerd die al voorbij het theoretische onderzoek waren en zich dus al minstens in een 'pilot-fase' bevonden.

9. Na het toepassen van bovenstaande relevantiefilters werden potentiële use cases gescoord op basis van zes evaluatiecriteria: effect op 5G-sensibilisering, gerealiseerde prestatiewinsten, duurzaamheid, innovatieve aard, implementatie van artificiële intelligentie & edge computing en maturiteit & schaalbaarheid. Enkel use cases met een voldoende hoge gewogen gemiddelde score op deze criteria werden uiteindelijk in de verzameling opgenomen. Er werden uiteindelijk 113 zulke use cases, die voldeden aan de gestelde voorwaarden, geïdentificeerd.

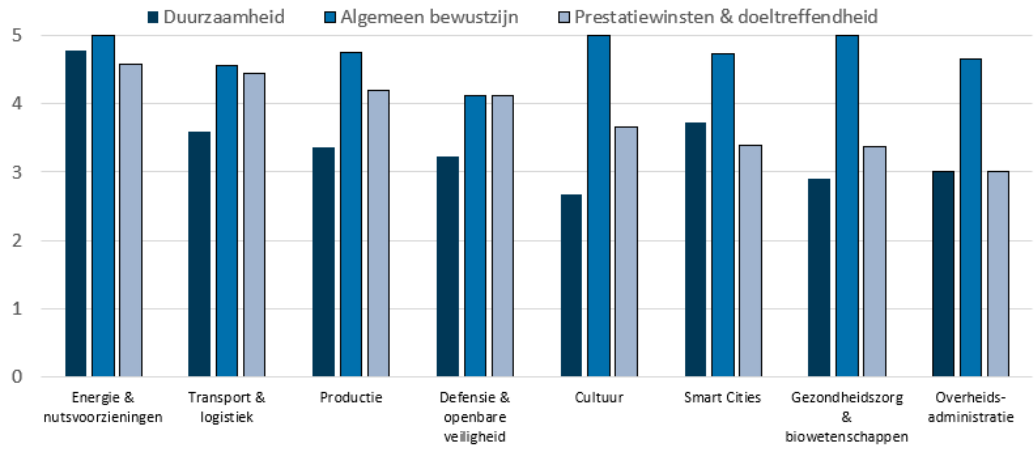
10. De geselecteerde sectoren scoren gemiddeld gezien het best voor het evaluatiecriterium 'algemeen bewustzijn rond 5G'. Ook voor het criterium 'prestatiewinsten & doeltreffendheid' worden over het algemeen hoge scores geobserveerd.

11. De geselecteerde sectoren scoren gemiddeld gezien het minst goed voor de evaluatiecriteria maturiteit en duurzaamheid. Voor het maturiteitscriterium hoeft dit geen verrassing te zijn, aangezien het hier gaat over een relatief nieuwe technologie. De lage score voor het duurzaamheidseffect vestigt de aandacht echter wel op een werkpunt, waarvan we bij de Belgische adoptie van 5G potentieel een speerpunt zouden kunnen maken.

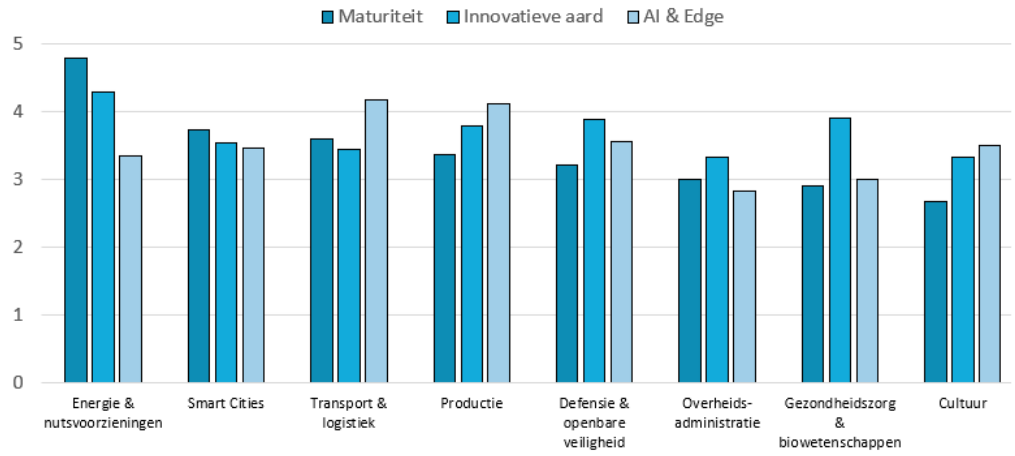


Figuur 2: gemiddelde criteriascores

12. De verschillende geselecteerde sectoren scoren niet voor alle selectiecriteria even goed of slecht, zoals te zien is op onderstaande figuren:



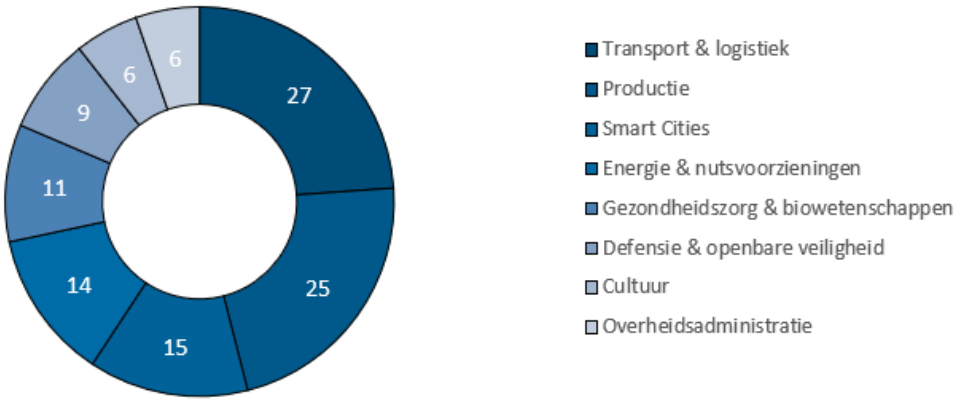
Figuur 3: gemiddelde criteriascores – per beschouwde sector



Figuur 4: gemiddelde criteriascores – per beschouwde sector (2)

13. Deze verzameling van 113 use cases bestaat voor het overgrote merendeel (88%) uit B2B-gerichte use cases. Dit is een verschil tegenover de 4G-technologie, die zich meer op het consumenten-gedeelte van de markt richt.

14. De verzameling bestaat voor bijna een kwart van de gevallen uit use cases die aansluiting vinden bij de sector van het transport en de logistiek (24%). Wanneer daar de productie- (22%) en 'smart city'-toepassingen (13%) bijgeteld worden, maken deze use cases samen meer dan de helft (59%) van de verzameling uit. Use cases vanuit deze sectoren voldeden het vlotst aan de hierboven uiteengezette selectiecriteria. Deze sectoren lijken dan ook het grootste potentieel te bieden voor het bijdragen aan de succesvolle omarming van 5G in België. Daarnaast bieden ook projecten binnen de sectoren van de gezondheidszorg & biowetenschappen (10%), de energie & nutsvoorzieningen (12%), defensie & openbare veiligheid (8%), cultuur (5%) en overheidsadministratie (5%) enig potentieel.



Figuur 5: aantal use cases per sector

VERZAMELING VAN 5G-PRAKTIJKGEVALLEN

ALGEMENE STUDIE OVER DE IMPLEMENTATIE VAN 5G IN HET BUITENLAND

Methodologisch en beschrijvend rapport

April 2022

Inhoudsopgave

1 Inleiding

Door omstandigheden is België laat met het toekennen van gebruiksrechten voor 5G-spectrum. Deze achterstand stelt ons echter in staat om te leren van andere landen waar reeds met succes 5G-initiatieven zijn doorgevoerd.

De bedoeling van deze studie is om een overzicht te bieden van geslaagde 5G-projecten in het buitenland, die als inspiratie kunnen dienen voor de Belgische markt. Dit verslag maakt deel uit van het initiatief '*Telecom to the next level*' van de minister van Telecommunicatie, dat voorziet om over de komende 3 jaar cumulatief 24 miljoen euro te investeren in de uitrol van 5G-demonstratieprojecten. De focus ligt in deze studie op praktijkgevallen die interessant zouden kunnen zijn op gebieden waarvoor de federale regering bevoegd is, aangezien het deze gebieden zijn waar de subsidies zich op zullen richten. Deze studie focust zich daarnaast op Europese lidstaten, Aziatische regio's (waarvan China de dominante speler is op vlak van 5G) en, in mindere mate, op de Verenigde Staten[1].

Met 'relevante praktijkgevallen' (*use cases*) worden in deze studie doorgaans praktijkgevallen bedoeld die effecten vertoond hebben die aansluiten bij de doelstellingen van '*Telecom to the next level*', namelijk het teweegbrengen van een zo snel en breed mogelijke adoptie van 5G-toepassingen door de Belgische stakeholders. Voor deze studie werden verschillende fases doorlopen om de relevante praktijkgevallen te selecteren: een sectorale en geografische selectiefase, een selectiefase op basis van de ontwikkelings-status, en een strategische selectiefase. De sectorale selectiefase werd gecombineerd met een economische analyse van België[2], teneinde ervoor te zorgen dat de nadruk werd gelegd op thema's die reeds een belangrijke bron van waardecreatie vertegenwoordigen voor ons land en waarvoor de invoering van 5G een belangrijke katalysator voor verdere ontwikkeling kan zijn. Tijdens deze fase werd ook enkel gekeken naar domeinen die (grotendeels) onder de bevoegdheid van de federale regering vallen. Bij het geografisch filtreren werd gefocust op de andere leden van de Europese Unie, Aziatische regio's (voornamelijk China) en de Verenigde Staten. Bij de selectiefase op basis van de ontwikkelingsstatus werd de voorkeur gegeven aan de praktijkgevallen die al tastbare resultaten hebben opgeleverd. Ten slotte werd de strategische selectiefase gebaseerd op zes scorecriteria om de meest relevante praktijkgevallen te identificeren.

Het eindresultaat is een database die meer dan 200 5G-gerelateerde praktijkgevallen bevat, een verzameling van de daaruit geselecteerde meest relevante praktijkgevallen[3] en een uitgebreid verslag over de gehanteerde methodologie, de sterktes van de Belgische economie en de relevante praktijkgevallen uit het buitenland.

Opmerking: Dit document is het verslag dat hierboven bedoeld wordt. De verzameling van de 5G-praktijkgevallen is te vinden in de bijlage.

[1] De VS is niet één van de gebieden waaraan voorrang is gegeven bij de identificatie van de praktijkgevallen omdat de omstandigheden daar fundamenteel verschillen van die in Europese gebieden. Toch zijn in dat land enkele heel robuuste en niet-verwaarloosbare praktijkgevallen voorhanden die goede voorbeelden vormen, voornamelijk in de sector van de gezondheidszorg.
[2] Gebaseerd op data van de OESO.
[3] De database is de volledige lijst met alle praktijkgevallen, terwijl 'de verzameling' de verwerkte/gefilterde lijst met relevante praktijkgevallen is. De database is niet openbaar beschikbaar.

2 Methodologie van de studie

Voor deze studie werd een aanpak in drie stappen gevolgd om het selectieproces van de praktijkgevallen mogelijk te maken. De drie fases bestaan uit een sectorale- en een geografische selectiefase, vervolgens de ruwe aanvulling en verwerking van de database en tenslotte de consolidatie en synthese van de resultaten in dit rapport en in 'de verzameling'.

Waaruit bestaan de aanpak en de methode?

Figuur 1. Overzicht van de aanpak van de studie

Identificatie van relevante sectorale en geografische focus

- De sectorale selectie is het resultaat van de analyse van achttien Belgische sectoren. Deze analyse was enerzijds gebaseerd op het criterium van federale afhankelijkheid (d.w.z. of de sector al dan niet onder de federale bevoegdheid valt) en anderzijds gebaseerd op het vermogen van 5G om deze sector te beïnvloeden. Dit beïnvloedend vermogen werd beoordeeld door middel van vijf scoreparameters - aanvaarding van innovatie, toegevoegde waarde, marktrelevantie, 5G-belang en sectorale complexiteit. Elke sector kreeg een individuele score toegewezen voor elk van deze vijf parameters. Van deze scores werd vervolgens het gemiddelde genomen, op basis waarvan de sectoren gesorteerd werden om relevantie te bepalen.
- Geografisch gezien bestonden de onderzochte gebieden uit de Europese Unie 28 (dus inclusief het Verenigd Koninkrijk), Aziatische gebieden met een sterke focus op China, en (in beperkte mate) de Verenigde Staten. De Europese evenknieën van België de vergelijking doordat de economische en politieke omstandigheden sterkere gelijkenissen vertonen, terwijl China en de VS koplopers zijn wat 5G betreft.

Praktijkgevallen: verzameling, categorisering, filtering en verfijning

- De 5G-praktijkgevallen werden eerst verzameld in een uitgebreide Excel-database, uitgaande van het materiaal van het Capgemini 5G-observatorium, uitgebreid met gedetailleerd bureau-onderzoek. Deze database bevat meer dan 200 praktijkgevallen van over de hele wereld en uit alle sectoren. Deze bevat informatie over hun context, businessmodel, onderliggende technologieën, type (B2B/B2C), 5G-klassen (eMBB, uRLLC, mMTC), status (potentieel, proef, live), architectuur, verschillende stakeholders en partners, en toegevoegde waarde. Naar deze Excel-file wordt doorheen dit document verwezen als '**de database**'.
- De volledige database werd vervolgens verwerkt om de meest relevante praktijkgevallen te onthullen. Daartoe werd eerst rekening gehouden met de sectorale en geografische prioritering; concreet werden praktijkgevallen die niet tot de sectoren en gebieden op de shortlist behoorden, buiten beschouwing gelaten. Daarna werden de praktijkgevallen uitgefilterd op basis van hun staat van ontwikkeling, alsook op

basis van de toegekende strategische score. Deze score werd verkregen via zes criteriascores die geaggregeerd werden tot een gewogen gemiddelde dat de algemene robuustheid van het praktijkgeval voorstelt. Naar deze bewerkte database wordt doorheen dit document verwezen als '**de verzameling**'.

Consolidering van bevindingen en resultaten

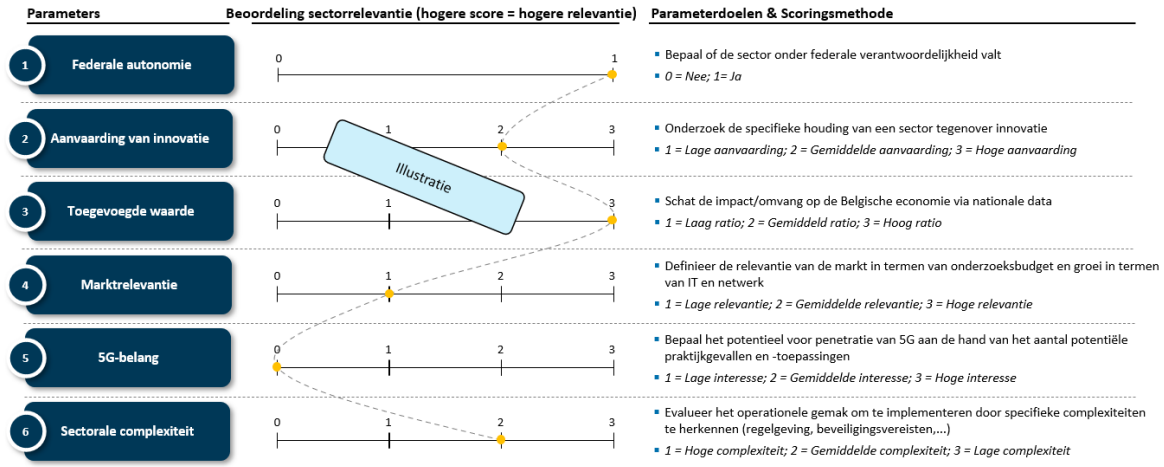
- De verzamelde informatie werd geanalyseerd, gesynthetiseerd en samengebracht in een rapport dat een overzicht geeft van de Belgische economie en de trends die zijn waargenomen bij voorgaande 5G-initiatieven in het buitenland.
- De verzameling van de meest relevante en interessantste praktijkgevallen is in een gestandaardiseerd formaat ontwikkeld om grote verschillen makkelijker te begrijpen en te benadrukken, voornamelijk door de informatie per sector te groeperen.

3 Sectorale beoordeling

3.1 Werkwijze

De sectorale beoordeling staat toe te achterhalen welke sectoren het potentieel hebben sterk beïnvloed te worden door 5G-applicaties. Deze beoordeling werd gebaseerd op kritieke parameters die voor België de relevantie en repliceerbaarheid van buitenlandse praktijkgevallen bepalen.

De kritieke parameters voor het uitkiezen van sectoren in België



Figuur 2. Parameters voor sectorale beoordeling & definities

De bij de sectorale beoordeling gebruikte parameters zijn, zoals beschreven in figuur 2:

- federale autonomie: al dan niet onder federale bevoegdheid vallen;
- aanvaarding van innovatie: niveau van integratie van innovatieve oplossingen;
- toegevoegde waarde: impact/gewicht in de Belgische economie;
- marktrelevantie: onderzoek en ontwikkeling en (technologisch) marktpotentieel;
- 5G-belang: vooraf bestaande en/of mogelijke take-up van 5G;
- sectorale complexiteit: wettelijke aspecten, veiligheid of andere rigiditeiten.

De vijf andere parameters dan 'federale autonomie'[4] werden gescoord op een schaal van nul tot drie. Wanneer een parameter een waarde krijgt onderaan op de schaal (met name nul of één) dan is de relevantie laag. Krijgt de parameter een waarde bovenaan op de schaal (bijv. drie) dan is de relevantie hoog.

Vanuit het oogpunt van de federale bevoegdheid waren de sectoren die meteen werden gevalideerd de volgende: transport & logistiek, gezondheidszorg en biowetenschappen, openbare veiligheid & defensie, slimme steden, cultuur en overheidsadministratie. Volgende sectoren werden daarentegen onmiddellijk uitgesloten: auto-industrie, media & entertainment, hightech, bouw, slimme kantoren, landbouw, kleinhandel en

[4] De sleutelparameter 'federale autonomie' maakte een voorlopige filtering van de verschillende sectoren mogelijk, door enkele domeinen aan te wijzen die volledig buiten de federale verantwoordelijkheid vallen. Als gevolg hiervan werden de sectoren voorlopig geëvalueerd op basis van deze parameter. Gezien de ambivalentie van de definitie van federale bevoegdheden, werden sommige domeinen rechtstreeks gevalideerd en uitgesloten, terwijl andere leidden tot verder onderzoek.

onderwijs. Ten slotte was er voor sommige sectoren verder onderzoek nodig vanwege van hun slechts gedeeltelijke federale afhankelijkheid. Deze sectoren waren: energie & nutsvoorzieningen, olie- en gasontginning, productie en financiële diensten.

3.2 Resultaten

Een groot aantal sectoren (18 in totaal) werden geanalyseerd:

- hun federale autonomie/afhankelijkheid werd geïdentificeerd;

  Sectoren die voor de parameter 'federale autonomie' 0 scoorden, dus niet onder de federale bevoegdheid, werden verder niet meer geanalyseerd, zodat ze om redenen van consistentie niet opgenomen zijn in deze tabel van resultaten[5].

- ze kregen een cijfer voor elk van de vijf parameters die voordien waren vastgelegd op een schaal van 1 tot 3[6].

Deze sectoren werden vervolgens gerangschikt om hun relatieve relevantie te bepalen op basis van een gemiddelde.

Resultaat van de sectorale analyse

Sector	Federale Autonomie (1: Federale bevoegdheid)	Toegevoegde waarde (1: Laag ratio)	Markt-relevantie (1: Lage relevantie)	Innovatie-aanvaarding (1: Lage aanvaarding)	5G-belang (1: Lage interesse)	Sectorale Complexiteit (1: Hoge complexiteit)	Score-resultaat (Gemiddelde)	Score-resultaat
Productie	1	3	3	3	3	2	2.8	
Gezondheidszorg & biowetenschappen	1	3	2	3	2	2	2.4	
Transport & logistiek	1	3	2	1.5	2	2	2.1	
Energie & Nutsvoorzieningen	1	2	2	2	2	2	2	
Defensie & openbare veiligheid	1	2	1	2	3	1.5	1.9	
Smart Cities*	1	2	1	2	3	1.5	1.9	
Financiële diensten	1	3	2	2	1	1	1.8	
Overheidsadministratie	1	2	1	3	1	1.5	1.7	
Cultuur	1	1	1	2	1	3	1.6	
Olie- & gasontginning	1	0.5	1	2	2	1	1.3	

*Schaal: 1 - 3; Behalve Federale autonomie, wat een waarde aanneemt van 1 of 0; * Vertegenwoordigt een verzameling/aggregatie van praktijkgevallen van de verschillende verticale markten*

Figuur 3. Resultaten van de sectorale beoordeling

Als gevolg van deze sectorale scan werden zes prioritaire sectoren geïdentificeerd voor de analyse van de praktijkgevallen. Het gaat om productie, gezondheidszorg & biowetenschappen, transport & logistiek, energie & nutsvoorzieningen, en defensie & openbare veiligheid. Daarenboven bleek het opportuun om nog twee andere sectoren te bespreken. Hoewel 'overheidsadministratie' en 'cultuur' niet bovenaan in de rangschikking stonden, worden ze in de verdere analyse opgenomen, wegens hun federaal afhankelijke aard. 'overheidsadministratie' is nauw verbonden met de federale werking, terwijl de federale overheid enkele bevoegdheden heeft inzake 'cultuur' (musea en federale wetenschappelijke instituten). Aan de andere kant worden financiële diensten (die hoger scoren dan cultuur) op het gebied van 5G – in de context van '*Telecom to the next level*' –

[5] Zie 3.1 Werkwijze (onderwijs, kleinhandel, landbouw, bouw, hightech, slimme kantoren, media en entertainment, en auto-industrie werden uitgesloten).
[6] Gebaseerd op gegevens van de OESO.

door Capgemini-experts als minder relevant beschouwd. Tot slot spelen olie- en gasontginning een verwaarloosbare rol in België en daarom werden deze uitgesloten van verder onderzoek.

Wat zijn de doelsectoren?

Figuur 4. Sectoren die voorrang krijgen

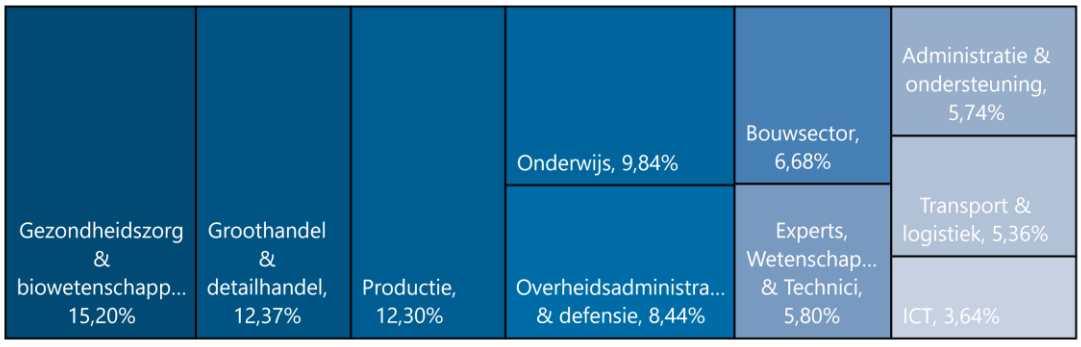
Uiteindelijk werden bovenstaande acht sectoren gemarkeerd als doelsectoren. Deze sectoren dienden als eerste filter bij de opsporing van relevante praktijkgevallen voor België.

3.3 Overzicht van de Belgische industrie

Hieronder wordt een overzicht van de Belgische markt gepresenteerd op basis van economische cijfers van de OESO.

De totale tewerkstelling in België bedraagt 4,8 miljoen personen. Dit aantal wordt grotendeels gedragen door de zorgsector, productie, en door groothandel en detailhandel. Opgeteld vertegenwoordigen openbare diensten, d.w.z. defensie, openbare veiligheid, openbaar bestuur, gezondheidszorg en cultuur, meer dan 35% van de totale tewerkstelling. Meer dan 50% van de beroepsbevolking is betrokken bij één van de acht bedrijfstakken die in de verzameling zijn opgenomen.

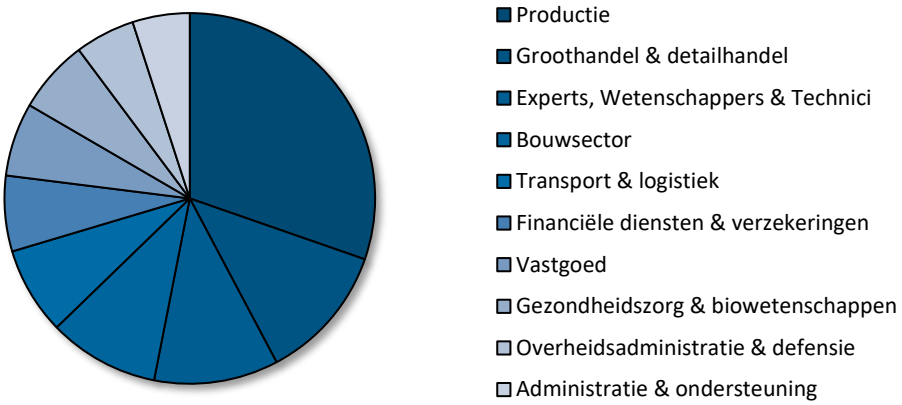
Welke sectoren stellen het meeste mensen tewerk in België (in % van het aandeel van de top 10 grootste sectoren)?



Figuur 5: Aandeel van sectoren in totale tewerkstelling in België (%)[7]

Het Belgische BBP wordt grotendeels ondersteund door de industriële en dienstensectoren - met name een kwart van alle output wordt gegenereerd door de verwerkende industrie, gevolgd door groothandel en detailhandel. Net als de waarnemingen voor de tewerkstellingspercentages per sector, vertegenwoordigen de acht geselecteerde sectoren 50% van de Belgische bruto-output. Dit impliceert dat de geselecteerde sectoren de Belgische productiviteit sterk ondersteunen.

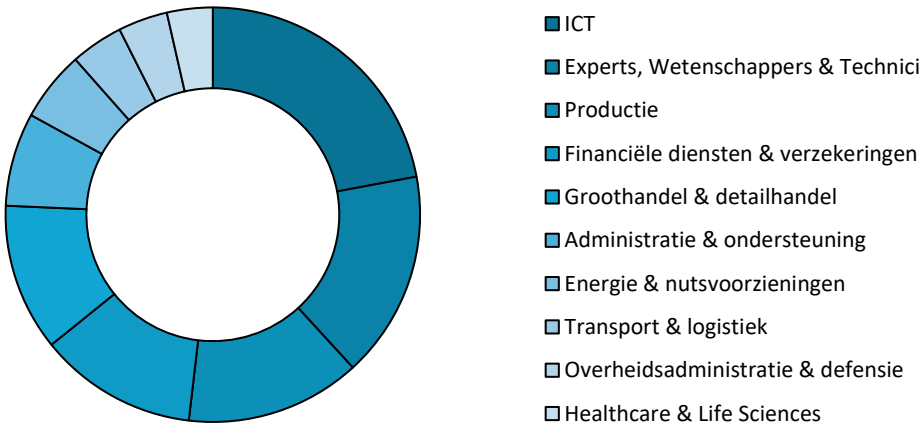
Welke sectoren dragen het meeste bij tot het BBP in België (in % van het aandeel van de top 10 grootste sectoren)?



Figuur 6: Aandeel van sectoren in totaal BBP van België (%)[8]

Op ICT-activiteiten na, die – zoals te verwachten is – de meeste investeringen in ICT kennen, is productie de op twee na grootste investeerder per jaar. Overheidsdiensten (administratie & defensie) nemen daarentegen minder dan 4% van deze investeringen voor hun rekening. Van de acht sectoren is de productiesector over het algemeen het meest klaar voor innovatie , aangezien deze sector 12,6% van alle ICT-investeringen in het land voor zijn rekening neemt, terwijl de overige 7 sectoren variëren van <1% tot 7%. Het is ook zo dat de productiesector al investeert in 5G en zich al voorbereidt op de implementatie ervan.

Welke industrieën staan het meest open voor innovatie op basis van hun investeringen (in % van het aandeel van de top 10 grootste sectoren)?



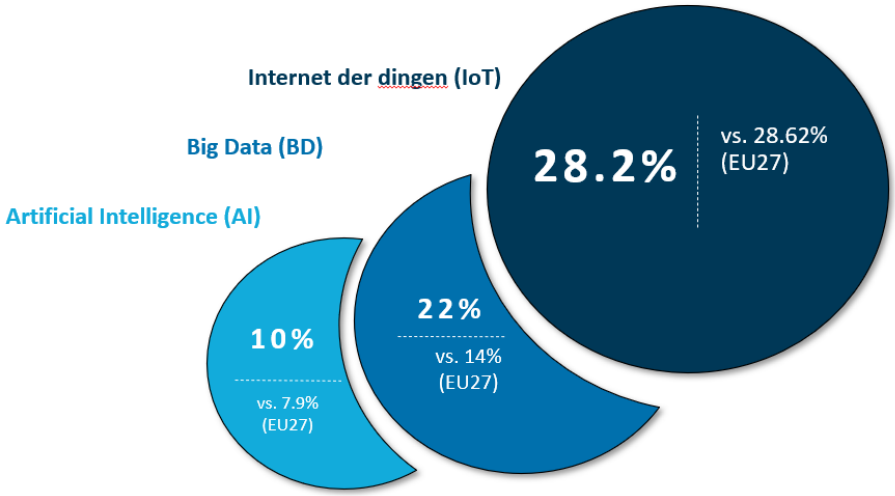
[7] Top 10 sectoren goed voor het merendeel van de totale werkgelegenheid (totaal aandeel >80%).
[8] Top 10 sectoren goed voor het merendeel van het BBP (totaal aandeel >80%).

Figuur 7: Aandeel van sectoren in bruto-investeringen in vaste activa in ICT in België (%)[9]

Hoewel België laat is met de implementatie van 5G, is het wel al een belangrijke gebruiker van drie belangrijke technologieën, het 'internet der dingen' ('*Internet of Things*', kortweg IoT), *big data* (BD) en artificiële intelligentie (AI):

- België ligt iets onder het Europese gemiddelde voor IoT-gebruik in het bedrijfsleven. De bedrijfstakken die deze implementatie in België stimuleren, zijn de bouw, productie en transport en logistiek, met een gebruikspercentage van respectievelijk 37%, 34% en 30%. De sector die het minst afhankelijk is van dit soort technologie is de administratie en ondersteunende diensten, met 21%;
- Big data wordt veel meer gebruikt in België dan in de rest van de EU; het land staat, wat het gebruik van BD betreft, op de vierde plaats van de 27 leden. Spelers op het gebied van transport en logistiek zijn de grootste gebruikers. Maar liefst 27% van de bedrijven in deze sector rapporteert namelijk gebruik te maken van big data. Deze sector wordt gevolgd door groothandel en detailhandel. Bovendien heeft BD in de loop der jaren over het algemeen terrein gewonnen, hoewel de schaal in de detailhandel en de administratieve & ondersteunende diensten aan het afnemen is;
- Het gebruik van AI blijkt in België uitgebreider te zijn dan in de rest van de lidstaten. Hoewel het gebruik van AI nog steeds relatief beperkt lijkt in vergelijking met de andere twee technologieën (IoT en BD), is het tussen 2020 en 2021 enorm populair geworden, vooral binnen ICT-activiteiten waar de implementatie van AI in slechts een jaar tijd meer dan verdubbeld is. Het gebruik van AI blijft laag in de sector transport en logistiek, waar het slechts 5,7% bedraagt.

Hoe is het gesteld met het gebruik van technologie in België?



Figuur 8: Gebruik van IoT, Big Data & AI in België

Over het algemeen zijn de economisch machtige sectoren (d.w.z. op basis van werkgelegenheid, bruto-output, enz.) slechts gedeeltelijk de sectoren die ook een groot potentieel hebben voor 5G-gebruik. In feite zijn meerdere sectoren uitgesloten van de scan vanwege hun federale onafhankelijkheid, hoewel ze hoge niveaus van ICT-investeringen genereren. Als gevolg hiervan traden industrieën zoals energie & nutsbedrijven, openbare veiligheid & defensie en cultuur naar voren. Consistent met de eerder gegenereerde resultaten, vertonen de productie-industrie, de gezondheidszorg en de biowetenschappen, alsook de transport- en logistieke sector potentieel voor sterke impactering door 5G.

[9] Top 10 sectoren goed voor het merendeel bruto-investeringen in vaste activa in ICT (totaal aandeel >90%).

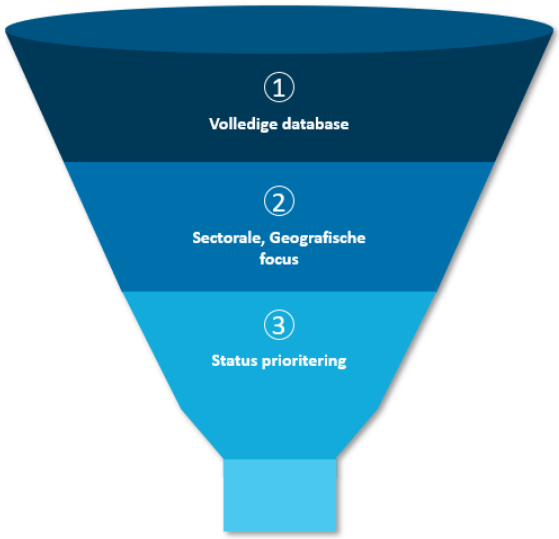
4 Selectie van de praktijkgevallen

De duizenden waarneembare praktijkgevallen zijn niet allemaal even relevant. Om dit probleem aan te pakken en de meest relevante voorbeelden te identificeren, werden de 5G-praktijkgevallen eerst verzameld in een uitgebreide database, die door verschillende verfijningsfases is gegaan teneinde de verzameling te ontwikkelen. De oorspronkelijke database praktijkgevallen begon vanuit het 5G-observatorium van Capgemini en werd aangevuld met gedetailleerd bureau onderzoek. Na het consolideren van de praktijkgevallen in een database, werden ze gesorteerd en gefiltreerd in 3 fases: sectorale en geografische selectie, prioritering op basis van de status, en ten slotte strategische selectie.

4.1 Trechter van de primaire selectie

De wereld telt een groot aantal 5G-praktijkgevallen die reeds geïmplementeerd zijn of die nog in ontwikkeling zijn. Daarom is het van fundamenteel belang om de praktijkgevallen te identificeren die een snelle opmars van 5G-toepassingen in België het best mogelijk maken. De oorspronkelijke database werd aldus onderworpen aan een primaire selectie, met inbegrip van de eerste twee fases van de schifting, namelijk sectorale en geografische selectie en prioritering van de status.

Welke primaire selectie hebben de praktijkgevallen ondergaan?



Figuur 9. Trechter van de primaire selectie

Aan de start waren meer dan 200 verschillende praktijkgevallen geïdentificeerd, waarbij alle types van toepassingen werden gedekt (geautomatiseerde voertuigen, drones, activiteiten van op een afstand, sensoren, slimme veiligheid, enz.) over een grote groep landen en in alle sectoren.

Deze 200 gevallen werden daarna gefiltreerd op basis van de sectorale en geografische restricties waarvan eerder in dit rapport sprake. Enkel de praktijkgevallen uit de acht sectoren[10] die in de sectorale beoordeling

[10] Productie, gezondheidszorg & biowetenschappen, transport & logistiek, energie & nutsvoorzieningen, openbare veiligheid & defensie, slimme steden, overheidsadministratie, cultuur.

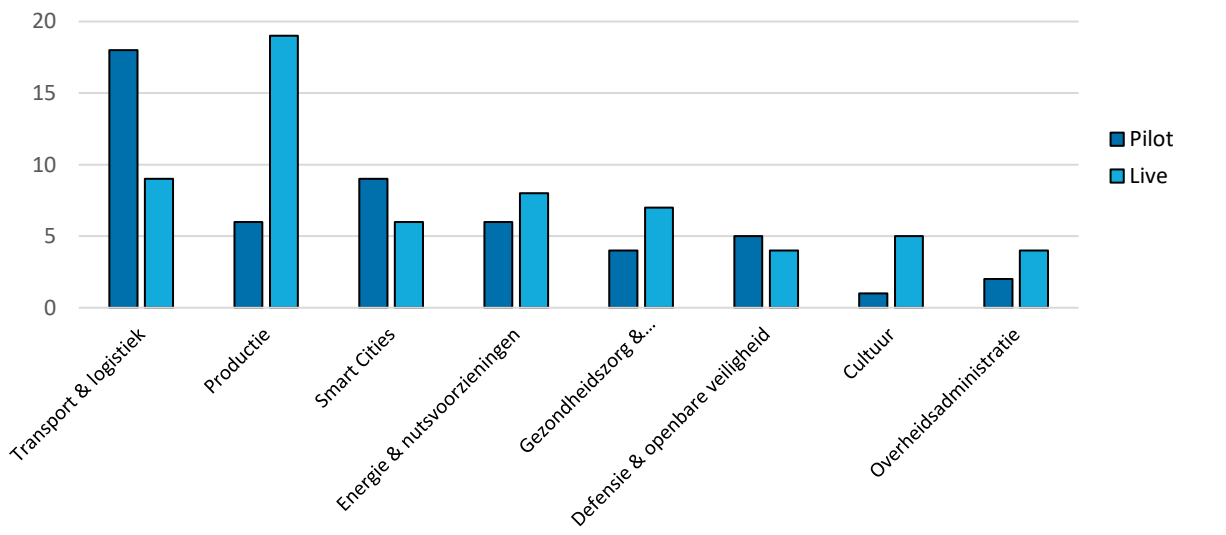
voorrang hadden gekregen en uit de verkozen geografische gebieden[11] werden voor verdere analyse in aanmerking genomen. Daardoor werd het toepassingsgebied beperkt tot 154 praktijkgevallen.

Deze 154 overblijvende praktijkgevallen werden vervolgens beoordeeld op basis van hun status. Er zijn immers drie statussen van uitrol vastgelegd:

- potentieel: nog niet operationeel op basis van 5G-technologie maar zou kunnen; ofwel omdat ze al draaien op vorige technologieën (bijv. 4G) en geüpgraded zouden kunnen worden naar 5G, ofwel omdat ze typische gevallen vertegenwoordigen die geschikt zijn voor 5G (bijv. AR/VR-opleiding);
- proef: in een testfase met 5G;
- live: werkt al regelmatig op basis van 5G.

Bij deze secundaire schifting zijn de praktijkgevallen die als 'potentieel' waren aangemerkt, buiten beschouwing gelaten om makkelijker de nadruk te kunnen leggen op goede praktijken die reeds tastbare resultaten hebben opgeleverd. Daardoor werden 23 praktijkgevallen uitgesloten. De gezuiverde[12] verzameling bestaat uiteindelijk uit 131 unieke praktijkgevallen, waarvan 55% een livestatus hebben. De meeste daarvan - 80% - zijn van het B2B-type.

Wat zijn de voornaamste eigenschappen van de verzameling (in dit stadium)? (Sector & status)



Figuur 10. Uitsplitsing praktijkgevallen per sector & status

Na de primaire en secundaire schifting is transport & logistiek de sector met het hoogste aantal praktijkgevallen, waarvan de meerderheid nog in de proeffase zitten. In termen van livepraktijkgevallen is de productiesector dominant binnen de verzameling. In het algemeen is de technologie nog niet rijp omdat een groot aandeel van de praktijkgevallen nog in de proeffase zit - ongeveer 40%.

[11] Europese Unie, Aziatische gebieden, Verenigde Staten. De VS is niet een van de gebieden die voorrang krijgen bij de identificatie van praktijkgevallen omdat de omstandigheden daar fundamenteel verschillen van die in Europese gebieden. Toch zijn in dat land enkele heel robuuste en niet-verwaarloosbare praktijkgevallen voorhanden die goede voorbeelden vormen, met name in de sector van de gezondheidszorg. Ook in België zijn er voorbeelden van 5G-toepassingen, maar deze zijn buiten beschouwing gelaten om de focus op het buitenland te behouden.

[12] Met 'gezuiverde verzameling' wordt hier de pre-definitieve verzameling bedoeld, strategische filtering moet in dit stadium nog worden toegepast.

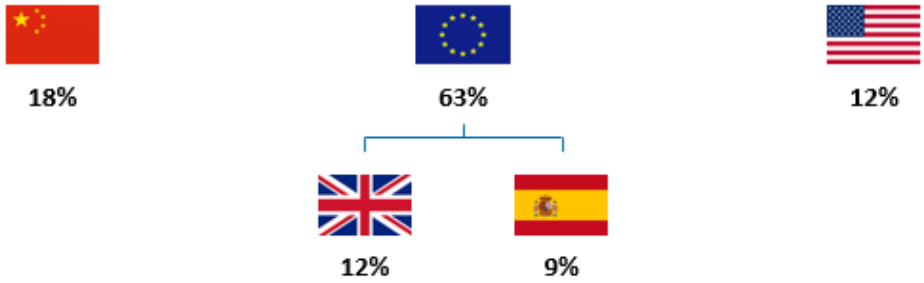
Wat zijn de voornaamste eigenschappen van de verzameling in dit stadium? (Zakelijke gebieden)

Figuur 11. Top van de zakelijke gebieden

5G lijkt duidelijk bepaalde zakelijke gebieden vaker te ondersteunen dan anderen. Drie zakelijke gebieden zijn immers regelmatig betrokken in de verschillende praktijkgevallen die geïdentificeerd zijn na de eerste twee screeningrondes[13]:

- operationele ondersteuning in 76% van de gevallen;
- verbetering van de procesbeheersing in 34% van de gevallen;
- verbetering van de klantendienst/-ervaring in 30% van de gevallen.

Wat zijn de voornaamste eigenschappen van de verzameling in dit stadium? (Landen)



Figuur 12. Top van de landen

Vanuit een geografisch oogpunt zijn meer dan 50% van de praktijkgevallen in de verzameling - na twee schiftingsrondes - gelinkt aan slechts vier verschillende landen. Specifiek komt 18% van de praktijkgevallen uit China, 12% uit de Verenigde Staten, 12% uit het Verenigd Koninkrijk en 9% uit Spanje.

Wat zijn de voornaamste eigenschappen van de verzameling in dit stadium? (Provider van de netwerkapparatuur)

Figuur 13. Top van de providers van de netwerkapparatuur

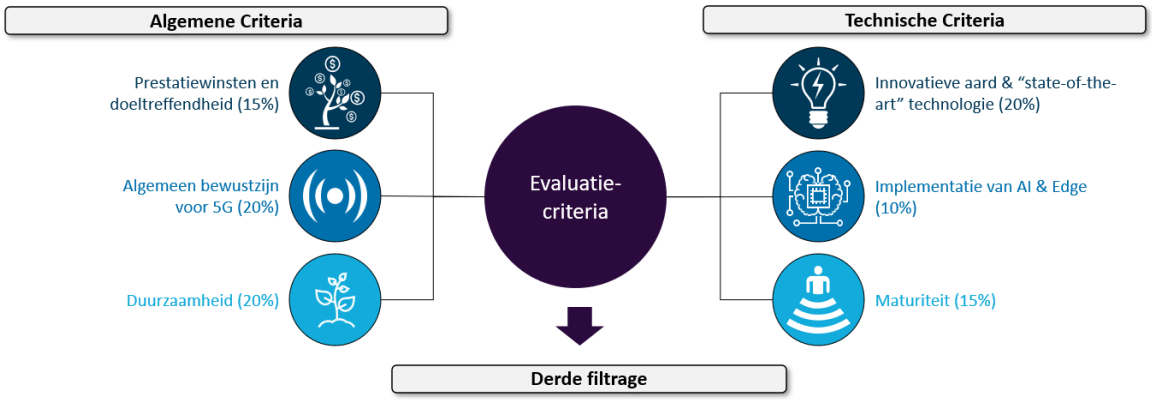
[13] Opgelet: het totaal is hoger dan 100% omdat de praktijkgevallen betrekking kunnen hebben op verschillende zakelijke gebieden tegelijk

Drie grote verkopers/providers van netwerkapparatuur domineren de verzameling. Het gaat om Ericsson, Huawei en Nokia. Zij zijn immers betrokken in bijna twee derde (62%) van de verzamelde praktijkgevallen.

4.2 Strategische selectie

Na de eerste twee schiftingsrondes werden de meest veelbelovende en geschikte praktijkgevallen geselecteerd via een strategische schifting. Aangezien het doel van deze studie is de sector te informeren in het kader van het initiatief '*Telecom to the next level*', is het voornaamste doel van de strategische schifting die praktijkgevallen te identificeren die duurzame effecten gehad hebben, die repliceerbaar zouden zijn en zouden leiden tot een snelle en brede implementatie van 5G in België. Teneinde deze doelstellingen te bereiken, werden zes criteria gelinkt aan maatstaven die de Belgische groei en ontwikkeling ondersteunen gedefinieerd. Deze criteria hebben de uiteindelijke prioritering van 5G-toepassingen bepaald.

Hoe zijn de meest veelbelovende en geschikte praktijkgevallen geselecteerd?



Figuur 14. Selectiecriteria

De zes maatstaven zijn verdeeld in twee categorieën. Enerzijds zijn er de algemene criteria die de economische en maatschappelijke bijdrage van het praktijkgeval betreffen:

- prestatiewinsten & doeltreffendheid van investering: beoordeling van de toegevoegde waarde en de resultaten/voordelen van de investering geleverd door het praktijkgeval in vergelijking met de aanvankelijke situatie;
- algemeen bewustzijn voor 5G: schatting van de bijdrage en promotie van het praktijkgeval tot het algemene bewustzijn voor de mogelijkheden, voordelen en gebruik van 5G door sectoren/organisaties/enz.;
- duurzaamheid: onderzoek van potentiële impact inzake duurzaamheid van het praktijkgeval, hetzij op het klimaat en het milieu, hetzij op sociale en economische aspecten.

Anderzijds zijn er de technische criteria waarbij de architectuur en de ontwikkeling van het praktijkgeval betrokken zijn:

- innovatieve aard & state-of-the-art-technologie: analyse van de aanvankelijke situatie tgov. na de implementatie van 5G, de relatieve bijdrage ervan waarbij de accuraatheid, duidelijkheid en de scope van het doel van het project in aanmerking worden genomen, en het gebruik van opkomende technologie;
- implementatie van AI & Edge: identificatie van de componenten in verband met artificiële intelligentie en de edge in het praktijkgeval (bijv. ML, VR, enz.);
- maturiteit: beoordeling van de schaal van ontwikkeling en uitrol van het praktijkgeval, de 5G-enablers (eMBB, uRLLC, mMTC) en de uniciteit van het praktijkgeval.

Het toekennen van scores voor elk van deze criteria gebeurde als volgt:

- elk praktijkgeval kreeg een score voor elk criterium op basis van een driedimensionale schaal, Hoog – Medium – Laag (HML)[14]. Dit werd dan omgezet in een kwantitatieve schaal met een maximum van 5 (5 = H; 3 = M; 2 = L). De spreiding tussen elk increment werd mathematisch getest en bepaald om een bevredigend evenwicht te krijgen tussen de sterkste en de zwakste praktijkgevallen[15];
- de scores van de zes criteria werden dan gecombineerd in één maatstaf via een gewogen gemiddelde. Het gewicht dat aan elk criterium is gegeven verschijnt tussen haakjes hierboven en stemt overeen met het relatieve belang van elk criterium in wat gedefinieerd wordt als een sterk praktijkgeval;
- ten slotte werd een minimale gewogen gemiddelde score van 3 bepaald als minimale grenswaarde voor de selectie opdat de uiteindelijke keuze enkel de beste praktijkgevallen zou bevatten (en waarbij diegene werden geëlimineerd die net het gemiddelde of daaronder bereikten).

[14] De HML-methode stemt overeen met een kwalitatieve rangschikking, de naleving waarvan wordt ondersteund door de sterke 5G-expertise van het team

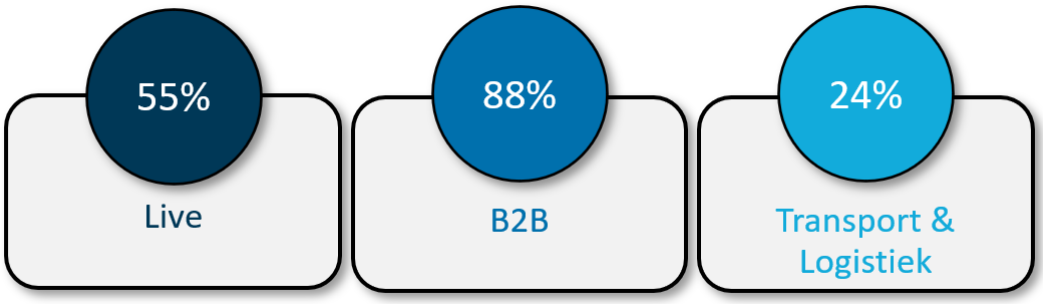
[15] Het toegekende cijfer wordt genuanceerd door verschillende, soms nauwelijks zichtbare, factoren, die in elk criterium invloed hebben op de bijdrage. Een bepaald praktijkgeval dat een aanzienlijke verlaging van de operationele kosten voorstelt kan bijvoorbeeld toch maar een gemiddeld krijgen in de indicator 'prestatiewinsten & doeltreffendheid van investering' omdat ter compensatie ook een aanzienlijke verhoging van de kapitaalsuitgaven vereist is. Een ander voorbeeld gaat over duurzaamheid; een praktijkgeval dat duurzaamheidsdoelstellingen aankondigt kan misschien enkel focussen op een beperkte reeks duurzaamheidsaspecten en daarom voor dit criterium geen 'hoog' krijgen.

5 Analyse van de verzameling 5G-praktijkgevallen

Dit hoofdstuk vat eigenschappen van en bevindingen over de finale verzameling samen.

5.1 Voornaamste eigenschappen

Wat zijn de verhoudingen van de praktijkgevallen in termen van status, type en sector?



Figuur 15. Voornaamste eigenschappen van de definitieve verzameling

Wat de status van uitrol betreft[16]:

- meer dan de helft van de praktijkgevallen zijn commercieel gestart of worden althans in één of verschillende locaties op regelmatige basis toegepast om voordelen en redenen voor de toepassing eruit te halen;
- niettemin zijn enkele proefgevallen op de goede weg en hebben die al veelbelovende resultaten opgeleverd die ten volle benut kunnen worden.

Wat betreft het type van praktijkgevallen (B2B of B2C):

- de uitrol van 5G opent nieuwe mogelijkheden en in het bijzonder voor zakelijke toepassingen; zulke toepassingen maken dan ook het gros van de geïdentificeerde praktijkgevallen uit;
- eerder ontwikkelde netwerken, nl. 2G, 3G en 4G, hadden daarentegen kenmerken die eerder gunstig waren voor de consumentenmarkten;
- bevinden zich ook veel B2C-praktijkgevallen in de database, vooral in de sectoren gaming, media & entertainment, kleinhandel en cultuur[17].

Wat betreft de voorkeursectoren:

- bijna een kwart van de praktijkgevallen zijn gericht op de sector transport & logistiek, met inbegrip van verschillende oplossingen zoals zelfrijdende voertuigen, onderhoud van op een afstand, geautomatiseerde havens, en vele andere;
- de productiesector komt op de tweede plaats, met 22% van de praktijkgevallen;
- de cultuur- en overheidsadministratiesectoren zijn elk maar goed voor 5%.

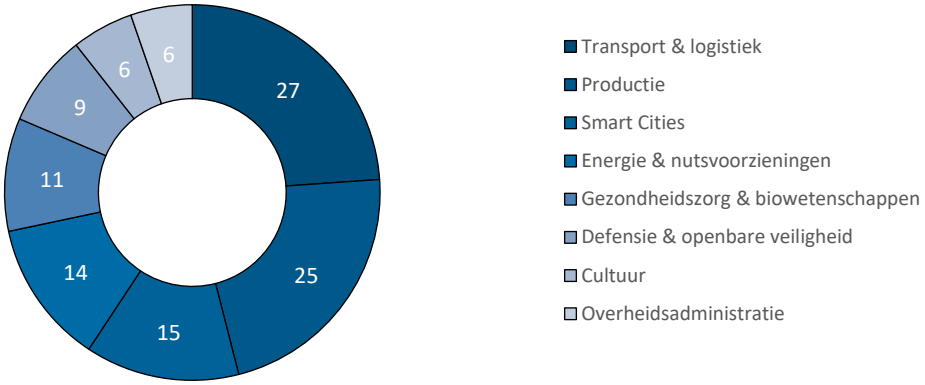
[16] Er wordt geen informatie gegeven over de praktijkgevallen die voordien gedefinieerd waren als 'potentieel', aangezien ze in de tweede screeningronde geëlimineerd waren.
[17] Een groot deel van de B2C-praktijkgevallen werden afgewezen hetzij omdat ze niet voldeden aan de interessegebieden, hetzij omdat ze de vereiste minimumdrempel niet haalden.

5.2 Sectorale en geografische uitsplitsing

Naast de algemene eigenschappen kunnen een aantal geprivilegieerde gebieden geïdentificeerd worden. Transport en logistiek domineren immers de 5G praktijkgevallenverzameling vanuit een sectorale invalshoek.

Voordat de selectie werd doorgevoerd had de sector van transport & logistiek het hoogste aantal praktijkgevallen. Deze sterke positie blijft overeind na de primaire en secundaire schifting en de strategische selectie, aangezien de sector op z'n eentje goed is voor bijna een kwart van de voornaamste gevallen. In het algemeen komen industriële activiteiten naar voren als meer geavanceerd in de ontwikkeling van 5G in vergelijking met diensten, zoals cultuur of overheidsadministratie.

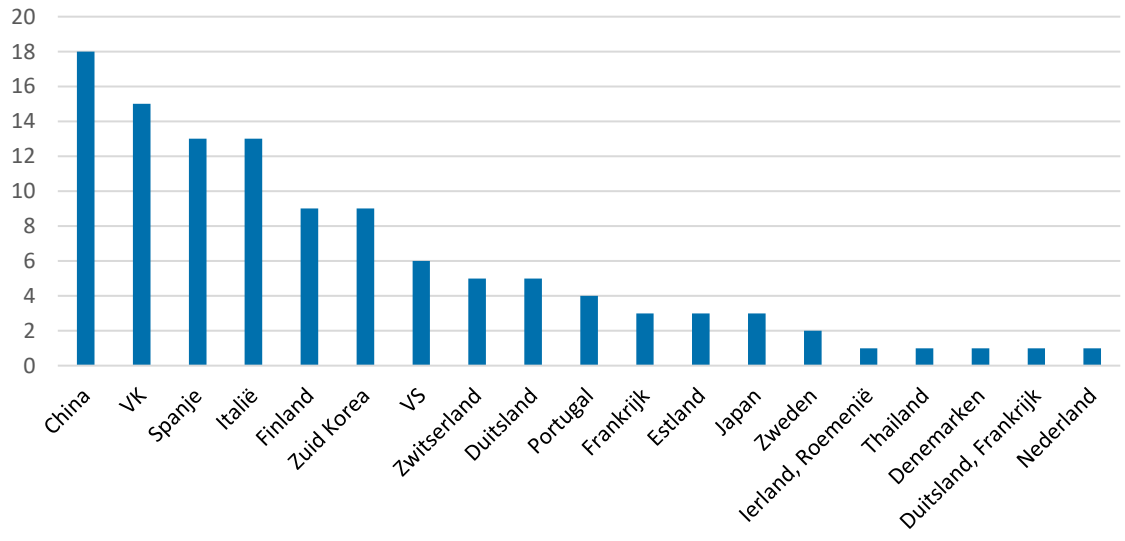
Waar vinden we de relevante praktijkgevallen? (Sectoren)



Figuur 16. Aantal praktijkgevallen per sector

Er is een groot overwicht van China wat 5G-technologie betreft, want bijna 20% van de beste praktijken uit de verzameling komen uit dat land. Verscheidene Europese landen liggen evenwel niet ver achterop - met name het VK, Spanje en Italië. Hoewel Portugal pas onlangs 5G op de markt heeft gebracht, zit het in de top 10 van de landen die de best scorende toepassingen aanbieden; m.a.w. een snelle integratie van de technologie.

Waar vinden we de relevante praktijkgevallen? (Landen)



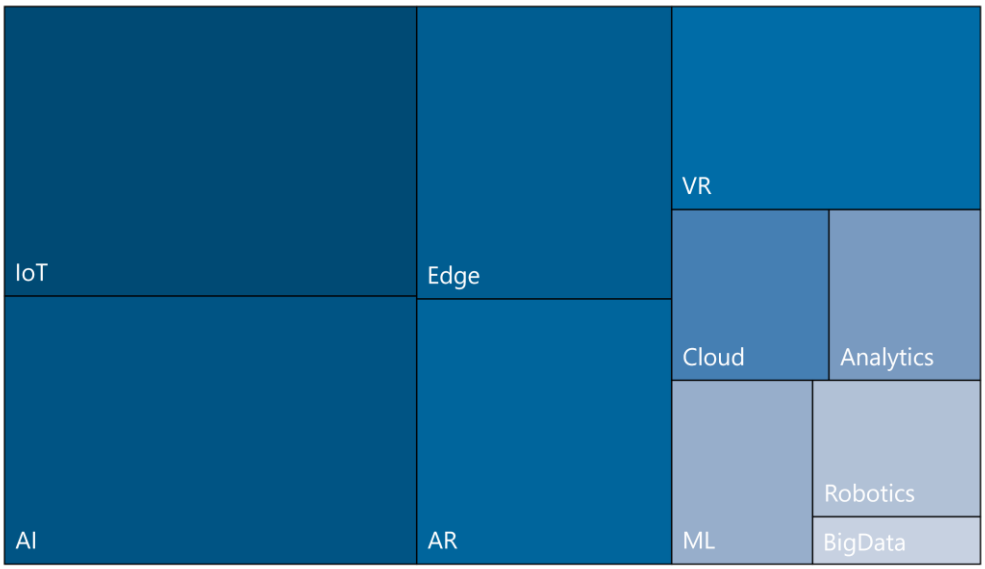
Figuur 17. Aantal praktijkgevallen per land

5.3 Technologie

Verscheidene technologieën zouden door de integratie van 5G geüpgraded kunnen worden. Daaronder worden vaak IoT, Edge Computing, Big Data en AI naar voren geschoven. Op basis van OESO-dataextractie en -analyse zit België aan de ene kant in een goede positie in vergelijking met zijn Europese evenknieën wat betreft AI en Big Data. Daarom zou de uitrol van 5G zeker een enorme versnelling kunnen teweegbrengen voor activiteiten die van die twee technologieën gebruik van maken. Aan de andere kant zou de 5G-uitrol, hoewel de scope van IoT in België nauwelijks minder uitgesproken is in vergelijking met de rest van de EU[18], ook een boost kunnen geven om 5G te integreren.

Hoewel 5G-gebruik intrinsiek gelinkt is aan verscheidene digitale oplossingen - waarbij veel technologieën betrokken zijn zoals automatisering, drones, geconnecteerde camera's, sensoren, enz. - verschijnen in de verzameling 10 technologieën veel vaker dan andere. Specifieker gesteld: 80% van de geïdentificeerde praktijkgevallen houdt verband met die 10 technologieën.

Welke technologie wordt het vaakst ondersteund door 5G?



Figuur 18. Top 10 van geïntegreerde technologieën[19]

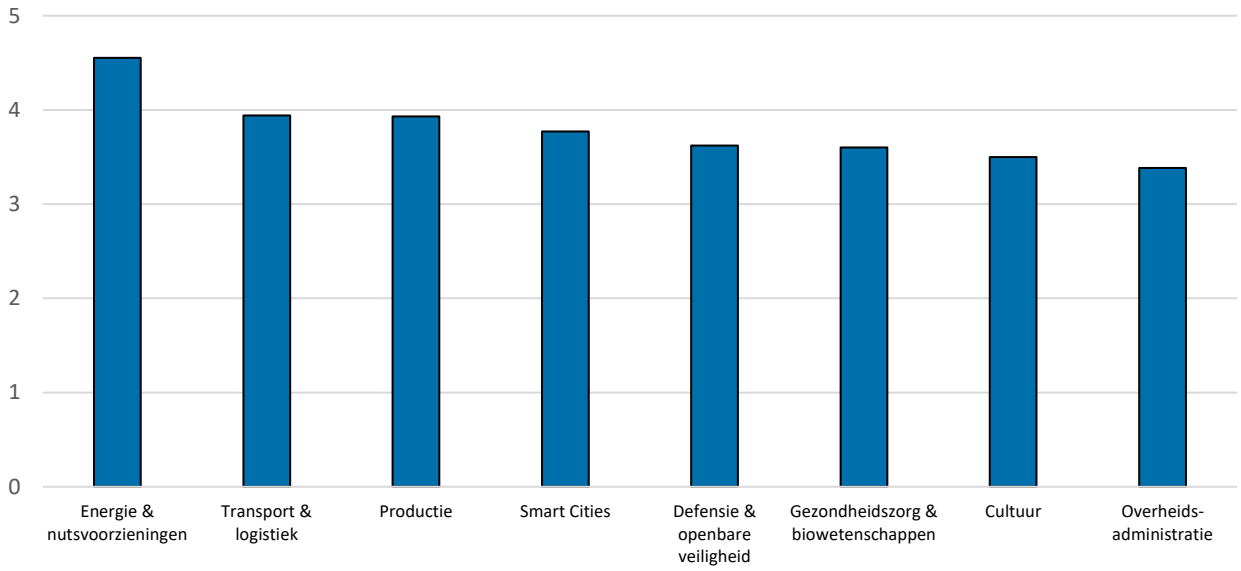
De overheersende technologieën zijn het internet van de dingen (IoT), artificiële intelligentie (AI) en the Edge. Big Data komt op de 10e plaats, onder de 70 verschillende technologieën. Dit zijn eigenlijk technologieën die nauw verband houden met 5G, of die ten minste versterkt kunnen worden door de integratie van 5G. Wetende dat België in een goede positie zit in termen van AI en Big Data in vergelijking met de andere Europese landen, en dat bijna een derde van de activiteiten uitgerust zijn met IoT, lijkt België de aantrekkelijke allereerste voorwaarden voor de implementatie van 5G applicaties te hebben.

[18] Gebaseerd op gegevens van de OESO, IoT-gebruik in activiteiten - België: 28.2% vs. EU27: 28.62% (Hoofdstuk 3.1. Overzicht van de Belgische industrie).
[19] Goed voor 80% van alle technologieën die betrokken zijn bij 5G-praktijkgevallen.

5.4 Gemiddelde strategische score

De gemiddelde scores[20] benadrukken het meest ontwikkelde gebied in de 5G-praktijkgevallen: Energie & nutsvoorzieningen. De sector van energie en nutsvoorzieningen voldoet inderdaad aan alle vereisten, behalve wat de component AI en Edge betreft, die zwakker lijkt dan voor de andere voorname sectoren.

Welke sectoren zijn het relevantst volgens gewogen gemiddelde score?



Figuur 19. Gemiddelde score per sector

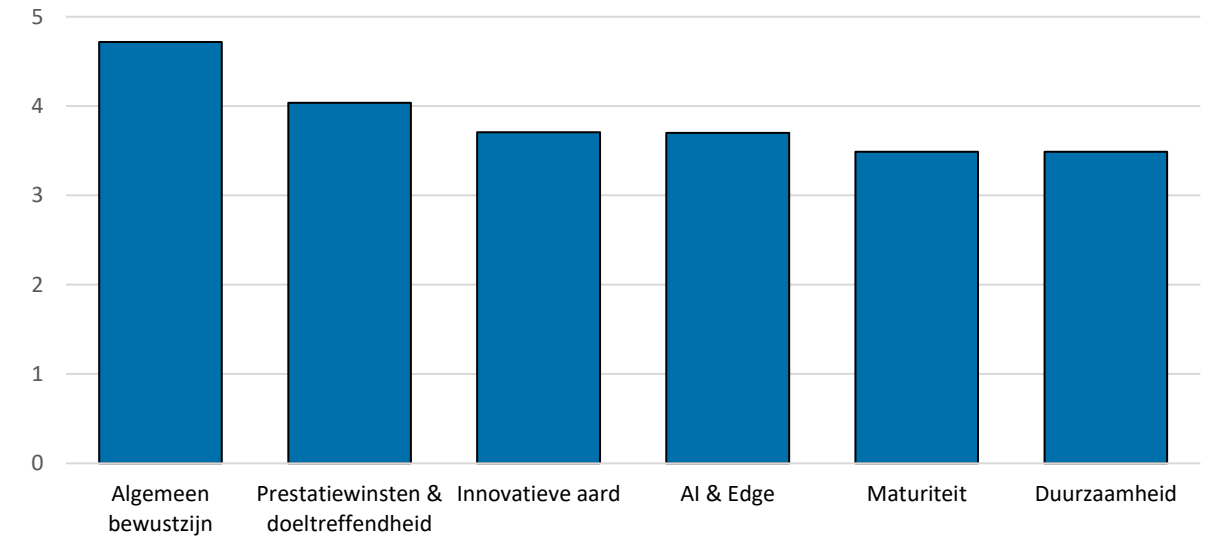
Hoewel de sector van energie & nutsvoorzieningen niet het hoogste aantal praktijkgevallen telt[21], lijkt het de meest gesofisticeerde te zijn, aangezien de gemiddelde score van die sector het hoogst is, nl. 4,55 (op 5). Transport & logistiek en productie volgen op de voet met geschatte scores van respectievelijk 3,94 en 3,93. Deze praktijkgevallen binnen deze drie sectoren zijn met andere woorden over het algemeen betrekkelijk robuuste voorbeelden, aangezien ze een relevantiescore[22] behalen van rond de 80%.

[20] Herinnering: De gemiddelde score is afgeleid van de scores voor de zes criteria, die dan gecombineerd werden in één maatstaf via een gewogen gemiddelde

[21] Transport & logistiek (27), productie (25) en slimme steden (15) zijn de top drie van sectoren met de meeste praktijkgevallen. Energie en nutsvoorzieningen volgt op de vierde plaats met 14 praktijkgevallen.

[22] De gewogen gemiddelde score kan worden beschouwd als een relevantiescore want het gaat om het cijfer dat is behaald voor de selectie van de meest relevante voorbeelden.

Welke criteria vormen de grootste uitdaging?



Figuur 20. Gemiddelde score volgens selectiecriteria

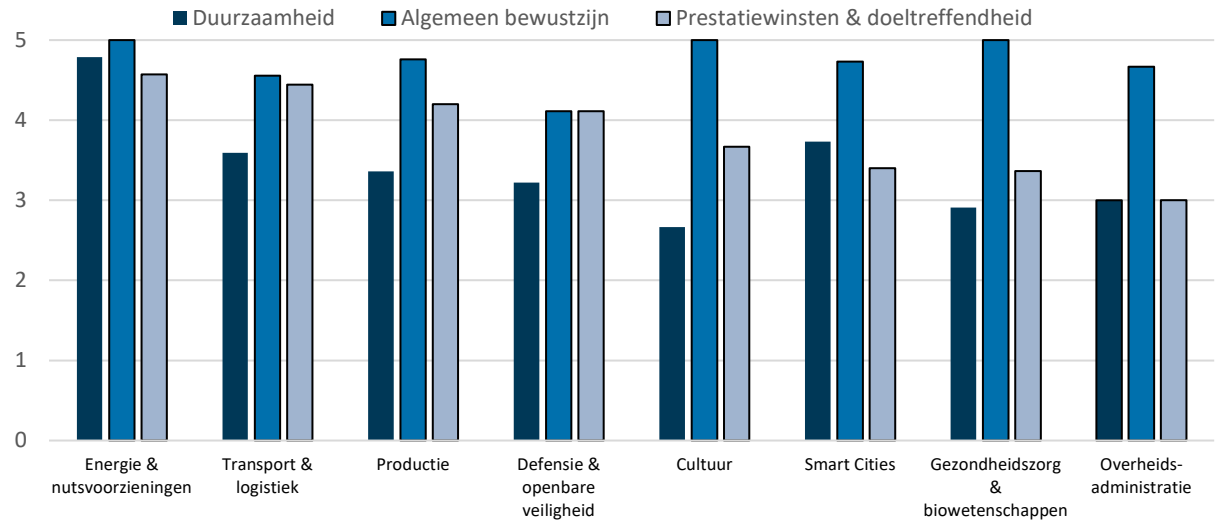
Er duiken verschillen op wanneer rekening wordt gehouden met de gemiddelde score per criterium. Sommige criteria behalen een hoger gemiddelde en worden beschouwd als hefbomen voor de implementatie van 5G. Andere halen lagere gemiddelden (dus dichter bij de drempel van 3) en vormen een grotere uitdaging voor de implementatie van 5G. Evenals de maatschappelijke belangen[23] is duurzaamheid minder vaak betrokken (laagste gemiddelde) en daarom ook een uitdaging wat 5G betreft. Algemeen bewustzijn voor de technologie laat daarentegen over het algemeen hoge cijfers zien, met een gemiddelde score van 88%.

Het gewogen gemiddelde van de zes criteria staat centraal in de beoordeling van de interessantste sectoren voor de praktijkgevallen. Toch is het in dezelfde mate van kritisch belang om hun consistentie te checken voor alle zes verschillende criteria apart. Het doel is met andere woorden om na te gaan of een sector stabiele scores haalt voor alle criteria en niet hoge scores voor slechts enkele ervan. Aangezien een gemiddelde immers een vertekende maatstaf kan zijn wegens uitschieters, werden ten slotte de scores van de sectoren geanalyseerd in figuur 21. Deze uitsplitsing werd gedaan om na te gaan of de sterke punten van de overheersende sectoren te danken waren aan een eenvormigheid voor alle zes de criteria, dan wel eerder het resultaat waren van enkele specifieke criteria.

De sterke sectoren - nl. transport & logistiek, productie en energie & nutsvoorzieningen - tonen consistente resultaten in elk van de algemene criteria. Daartegenover verhoogt de cultuursector het bewustzijn voor 5G aanzienlijk, maar zit deze maar net boven het gemiddelde wat het criterium duurzaamheid betreft. Bij slimme steden anderzijds, is er een duidelijke focus op datzelfde duurzaamheidsaspect, aangezien het de sector is met de op een na beste gemiddelde score voor deze maatstaf.

[23] United Nations (2021), *The Sustainable Development Goals Report 2021.* https://unstats.un.org/sdgs/report/2021/The-Sustainable-Development-Goals-Report-2021.pdf

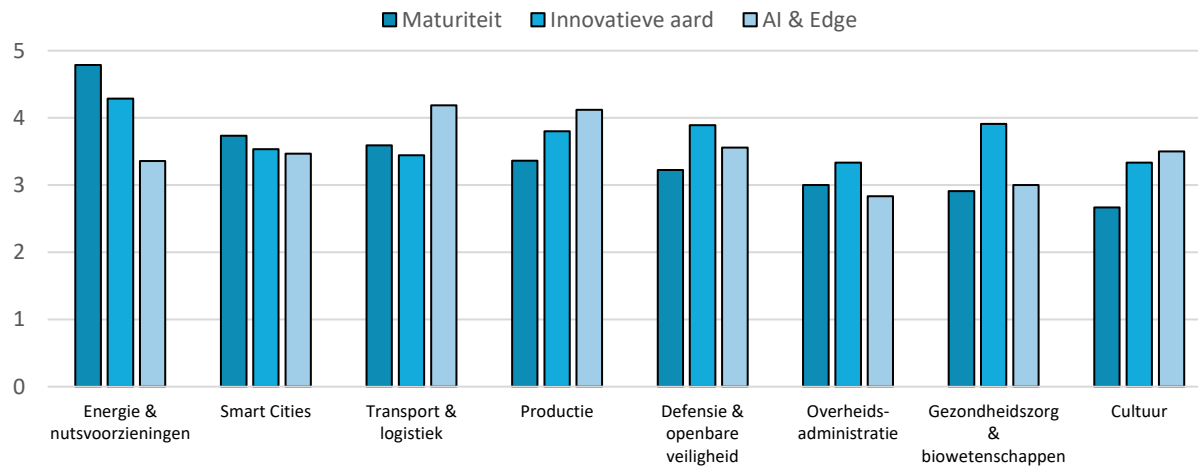
Zijn de sterke gebieden voldoende consistent om robuuste praktijkgevallen te zijn? (Algemene criteria)



Figuur 21. Gemiddelde score volgens algemene criteria & sector

Vervolgens springen de overheersende sectoren eruit met consistentie in de technische parameters. Anderzijds springen slimme steden voor deze aspecten er nog meer uit, in vergelijking met de algemene dimensies, aangezien ze op de tweede plaats staan qua maturiteit. Het is geen verrassing[24] dat de sectoren overheidsadministratie en cultuur toepassingen hebben die niet erg matuur of innovatief zijn en een lage AI/Edge-component hebben. De sector gezondheidszorg en biowetenschappen staat dan weer op de tweede plaats voor de innovatieve aard van oplossingen, maar die lijken nog altijd onderontwikkeld te zijn gezien het lage niveau van maturiteit.

Zijn de sterke gebieden voldoende consistent om robuuste praktijkgevallen te zijn? (Technische criteria)



Figuur 22. Gemiddelde score volgens technische criteria & sector

[24] Omdat dit de sectoren zijn die het minst vertegenwoordigd zijn in zowel de volledige als de gefilterde database. Dit kan zijn omdat 5G in deze domeinen nog niet ten volle benut is.

6 Conclusie

De achterstand van België op vlak van de uitrol van 5G kan zeker aanleiding geven tot bezorgdheid over de prestaties van de telecommunicatie-infrastructuur van ons land en, in het verlengde daarvan, over de concurrentiepositie en aantrekkelijkheid van België voor nieuwe investeringen. Deze vertraging in de implementatie biedt echter ook de mogelijkheid om te investeren in de nieuwste beschikbare technologieën en de mogelijkheid om te leren van ervaringen in andere landen.

Dit rapport presenteert daarom relevante praktijkgevallen uit verschillende industrieën. Voor grote branches zoals productie, gezondheidszorg en transport en logistiek zijn voorbeelden van relevante praktijkgevallen van over de hele wereld op grote schaal beschikbaar. Daarnaast zien we dat deze verticals over het algemeen ook gekenmerkt worden door hogere ICT-investeringen en een traditie om te innoveren. Ook in België is dit het geval. We zien dat grote bedrijven die op deze gebieden actief zijn zich bovendien al voorbereiden op de lancering van 5G. Als zodanig kan financiering voor deze industrieën zeker leiden tot de snelste en economisch meest effectieve initiatieven. Sectoren als openbare veiligheid & defensie, cultuur en overheidsdiensten vertonen een lagere reflex (en budget) om te innoveren en zouden als zodanig ook kunnen profiteren van financiële steun om 5G-toepassingen te integreren in hun bedrijfs- en bedrijfsprocessen.

België is al ver gevorderd met het toepassen van nieuwe technologieën zoals kunstmatige intelligentie, het internet der dingen, big data en edge computing. Deze technologieën zullen zeker profiteren van een performante 5G-infrastructuur en kunnen interessante use-cases opleveren. De aanwezigheid en knowhow van al deze technologieën zullen elkaar ondersteunen en de effecten van 5G-toepassingsimplementatie op de economie en de samenleving versterken.

Afgezien van enkele uitzonderingen zien we op dit moment slechts weinig praktijkgevallen gericht op duurzaamheid. Hoewel meerdere praktijkgevallen een indirect positief effect hebben op duurzaamheid, is het bereiken van duurzaamheid over het algemeen niet de eerste prioriteit. Als zodanig kan een focus op het ontwikkelen van relevante praktijkgevallen rond duurzaamheid zeker een unieke positionering op de wereldmarkt met zich meebrengen.

In het algemeen kunnen we concluderen dat België klaar is voor de implementatie van 5G-toepassingen. 5G mag samen met de andere technologieën geen doel op zich zijn, maar moet eerder worden beschouwd als een belangrijke ‘enabler’ voor praktijkgevallen die voordelen opleveren voor de samenleving en/of economie. Gezien de staat van paraatheid van de Belgische markt, lijkt België echter het perfecte podium om dergelijke voordelen te realiseren.

7 Lijst van de figuren

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Over Capgemini Invent

Als het merk van de Capgemini-groep dat zich toelegt op digitale innovatie, ontwerp en transformatie, stelt Capgemini Invent CxO's in staat om de toekomst van hun onderneming te voorzien en vorm te geven. Capgemini Invent telt meer dan 36 kantoren en 37 ateliers over de hele wereld en heeft een sterk team (meer dan 10.000 medewerkers) van strategen, datawetenschappers, product- en ervaringsontwerpers, merkexperten en technologen die nieuwe digitale diensten, producten, ervaringen en businessmodellen ontwikkelen voor een duurzame groei.

Capgemini Invent maakt integraal deel uit van Capgemini, een wereldwijde marktleider die als strategische partner organisaties ondersteunt bij hun transformatie en management door gebruik te maken van de kracht van technologie. Hierbij laat de Group zich leiden door zijn bestaansreden: menselijke energie vrijmaken door middel van technologie voor een inclusieve en duurzame toekomst. Capgemini is een maatschappelijk verantwoorde en multiculturele organisatie met 270.000 mensen in bijna 50 landen. Met meer dan 50 jaar ervaring en expertise in uiteenlopende sectoren, vertrouwen klanten de aanpak van hun zakelijke behoeften toe aan Capgemini: van strategie en ontwerp tot operationeel beheer. Dit gebeurt door gebruik te maken van innovaties in cloud, data, kunstmatige intelligentie, connectiviteit, software, digital engineering en platforms. De Group behaalde in 2020 een omzet van € 16 miljard.

5G USE CASE REPOSITORY

GLOBAL STUDY ON 5G IMPLEMENTATION ABROAD

March 2022

EXECUTIVE SUMMARY

Belgium's backlog of 5G deployment is a crucial window of opportunity for a seamless rollout

The 5G roll-out is now more than underway. Indeed, countries like China are frontrunners since 2018, while the EU27 completed its deployment panel in early 2022

- Belgium is lagging behind its European peers, notably because of the late 5G frequency auction.
- Most European countries are already targeting a population coverage between 90 and 100% and are simultaneously active in the low, medium and high bands, while Belgium only reaches a coverage of 4% with no band assigned at this stage. Furthermore, the maturity ratio, a function of the number of trials and their associated maturity, leaves Belgium far adrift of its Western European peers.
- This gap is to be grasped as an opportunity. 113 unique applications of 5G are already observable abroad and, the most developed of them are affiliated to the manufacturing and transportation & logistics sectors, which are partly the economic engines of Belgium. Moreover, the country's various activities are already making considerable use of three technologies that are intricately linked to 5G and for which its incorporation would allow significant gains, pecuniary or otherwise - namely, IoT, AI and Big Data.

The 113 unique and optimal use cases are endowed with typical key attributes enabling their categorization

- Regarding the status, more than half of the use cases are commercially launched or, at least, being applied in one or several locations on a regular basis to extract benefits and grounds for application. Nevertheless, some pilot cases are well underway and have already delivered promising outcomes that can be leveraged.
- While previously developed networks, i.e., 2G, 3G and 4G, displayed features favorable to the consumer market, the deployment of 5G opens the door to new avenues and, in particular, to the business applications that make up the bulk (88%) of the use cases identified. This is an observation for the prioritized sectors and following the criteria-based analysis. Many B2C use cases are still observable, especially in the gaming, media & entertainment, retail and culture sectors but were dismissed either because they did not fit into the focus areas or because they did not meet the minimum threshold required.
- China largely dominates 5G technology, with nearly 20% of the best-practices coming from the country. However, various European states are not far behind - notably, the UK, Spain and Italy. Although Portugal has only recently commercialized 5G, it is in the top 10 of countries providing the best-rated applications; i.e., a swift integration of the technology.

EXECUTIVE SUMMARY

The repository patterns outline potential directions to pursue for 5G implementation in Belgium

Industrial activities emerge as more advanced in the development of 5G (manufacturing, transportation & logistics, energy & utilities), compared to service activities such as culture or public administration

- Before the refinement (200+ use cases), the manufacturing industry is the most established in the deployment of 5G. Indeed, it has a high intensity of applications, and, among these, the frequency of live cases (i.e., already in regular use) exceeds that of pilot and potential cases.
- After the refinement (113 use cases), near to a quarter of the use cases are aimed at the transportation and logistics industry, including various solutions such as autonomous vehicles, remote maintenance, automated ports, and many others.
- Although the energy and utilities sector does not boast the highest number of use cases, it tends to be the most sophisticated, as the sector's average score is the highest, at 4.55 (out of 5). Transportation & logistics and manufacturing follow closely behind with estimated ratings of respectively 3.94 and 3.93.

The reached scores allow to identify the most leveraging as well as the most challenging dimensions; respectively those with the highest and lowest average score

- Similar to the societal concerns, sustainability is reported to be less often engaged and therefore also a challenge when scaled down to 5G. Awareness of the technology, however, shows generally high rates, with an average score of 88%.
- The so-called powerful sectors – i.e., transportation & logistics, manufacturing, and energy & utilities – exhibit consistent results in each of the general criteria as well as in the technical parameters.
- Smart Cities, on the other hand, has a clear focus on sustainability, as it is the sector with the second best average score for this metric. The healthcare & life sciences sector, meanwhile, is in second place regarding the innovative nature of solutions, but still seem to be underdeveloped in view of the lower level of maturity.

The technologies heavily involved in 5G implementation already underpin the Belgian organizations' activities

- The dominant technologies are the Internet of Things (IoT), Artificial Intelligence (AI) and the Edge. Big Data emerges in 10th position, among the 70 different technologies. These are, in fact, closely related sciences to 5G, or at least can be enhanced by the integration of 5G.
- Knowing Belgium's good positioning in terms of AI and Big Data compared to its European peers, as well as the fact that near to a third of the activities are equipped with IoT, Belgium seems to have the attractive preconditions for 5G.

5G REPOSITORY

THE REPOSITORY STORES THE USE CASES THAT HAVE PASSED THE VARIOUS FILTERING ROUNDS, AND TRACKS AN INTELLIGENT SEQUENCE OF INFORMATION

In summary, what is the methodology that has been used to build the repository?

Identification of the most robust use cases and best practices

Sectoral & Geographical Focus

Elimination of use cases not belonging to the eight highlighted sectors, as well as outside the European Union, the United States and Asian regions

Status Prioritization

Rejection of use cases in "potential" status

Strategic Selection

Removal of use cases not reaching an average score of 3 in all six criteria

Organization and grouping of information by sector

Fact Sheet and Challenges

Major market trends and challenges to overcome (mostly related to 5G – directly or indirectly)

Main actors' ecosystem and related 5G solutions

Pairing of the different actors and the use cases applicable to them - also serving as a table of contents by sector

Use case matrix mapping

Visual comparison tool between different 5G applications according to general and technical aspects (6 criteria)

Individual use case report *

Key description & features of each use case (status, context, business model & key actors, added value, ...)

** When the status of the use case is "Live", it refers to observed benefits. When the status of the use case is "Pilot", it mainly refers to expected benefits. In some cases, these are the benefits observed during the test phases and which are intended to be scaled. The quantified impact of the use cases is sometimes communicated, sometimes not. Therefore, the most accurate information is reported as often as possible.*

5G USE CASE REPOSITORY

Table of Contents

MANUFACTURING

The largest share of post-crisis GDP growth is attributable to the industrial sector, especially manufacturing (Growth of 1.3% QoQ).

NATIONAL ACCOUNTS

Value Added *(Euro, Millions)*
56,561

Labour input *(Persons, thousand)*
506

Gross Fixed Capital Formation *(Euro, Millions)*
14,157

Gross Fixed Assets *(Euro, Millions)*
242,396

CHALLENGES

More complex supply chain than ever

Production models must be reconsidered, especially in terms of resilience by multiplying the number of suppliers and building up more inventories.

Increasing labor costs and need for qualified staff

Spill over effects are reflected in the production costs and, consequently, on the margins and profitability.

Stricter social and environmental laws

New standards have been set up at European and national level, putting pressure to intensify the R&D efforts and investments to improve the manufacturing processes.

Growing competition and the need to differentiate

The 5.0 digital turnaround accelerates changes and requires significant investments (in capital as well as in human resources).

TRENDS

26% Of the added value of the country as well as 17% of the employment, hence manufacturing industry still plays a key role in the Belgian economy.

▲ 31% Production growth in August 2021 compared to the same month the previous year; while it bottomed out in April 2020 with 20.5% drop.

60% Of technological manufacturing were working on the transition to Industry 4.0 in 2019-2020.

MANUFACTURING ECOSYSTEM

Manufacturing And Plant Management

Inbound And Outbound Logistics

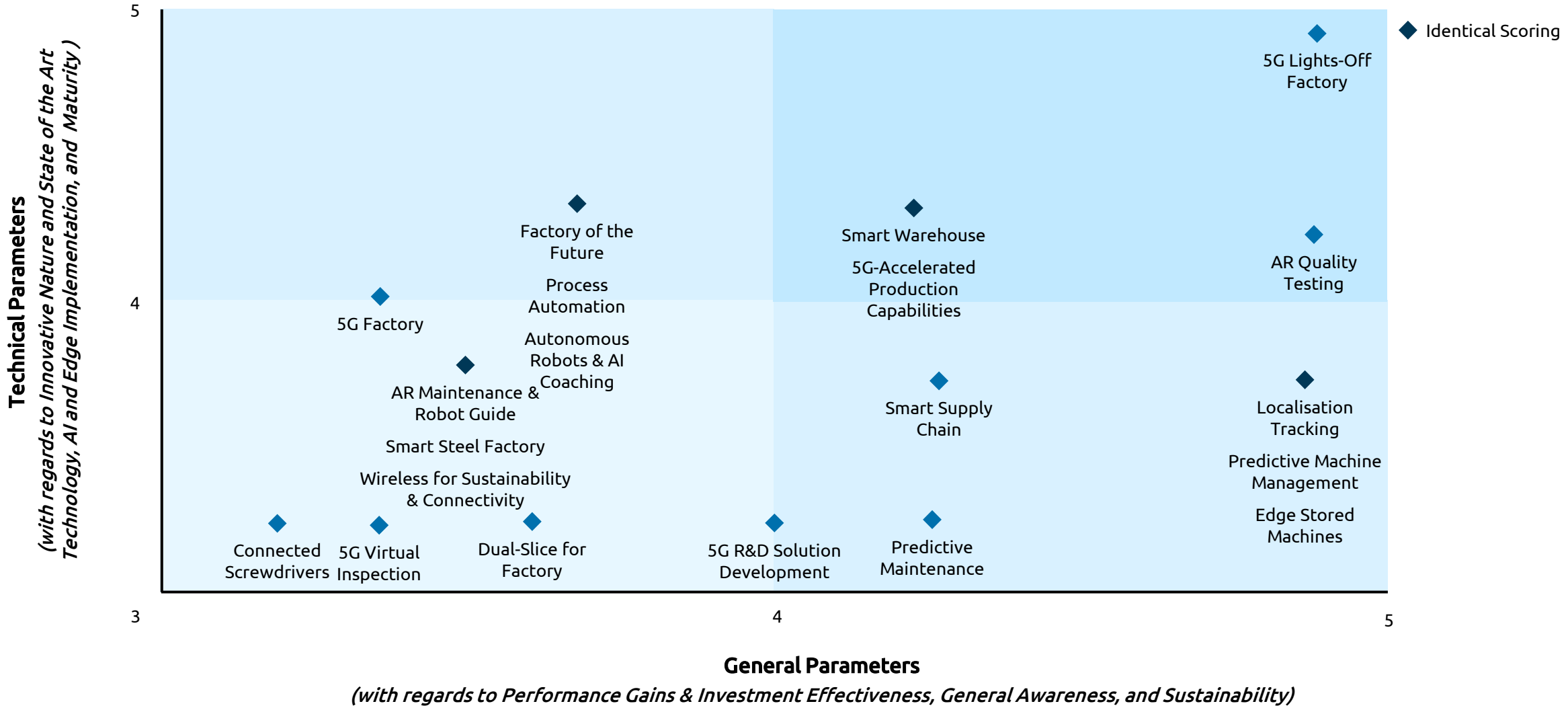
Human Resource Management

Sales & Marketing

5G use cases in each area of the ecosystem

- 5G Supported Virtual Inspection
- 5G Lights-Off Factory
- 5G-Accelerated Production Capabilities
- 5G Based Process Automation
- 5G-Powered Predictive Maintenance
- Wireless Factory Sustainability & Connectivity
- AR Maintenance & Robot Guide
- AR Quality Testing
- 5G Smart Steel Factory
- 5G Smart Warehouse
- 5G-Based Smart Supply Chain
- 5G-Automated Localization Tracking
- Predictive Machine Management
- Factory of the Future
- 5G Factory
- Autonomous Robots & AI Coaching
- Mobile Edge Cloud Stored Machines
- 5G Connected Screwdrivers
- Dual-Slice Solution for Factory
- 5G R&D Solution Development

MANUFACTURING USE CASES MAPPING



Lufthansa Technik

5G-Supported Virtual Inspection – Remote Machine Inspection

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- At Lufthansa Technik's facility, the hyperfast 5G private wireless network remove the need for customers to physically attend servicing, by providing seamless video access to the engine overhaul shop floor. Currently, customers travel to the plant to carry out components inspections when engines are overhauled, which means that they are entirely disassembled and inspected in utmost detail. With the new system, Lufthansa will perform inspections of individual engine parts collaboratively over a fast, high-definition video link.

Business Model & Key Actors

- Nokia and Lufthansa Technik, the leading provider of technical aircraft services, have deployed a 5G industrial-grade private wireless network to accelerate a project that enables remote engine parts inspection for its civil aviation customers.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: /

Technical Architecture

- The network is based on Nokia Digital Automation Cloud (DAC) 5G SA. Nokia DAC is an application platform providing high-bandwidth, low-latency, hyper-fast private wireless connectivity and local edge computing, which provides digitalization enablers. Over a video stream, customers communicate in real time with engine mechanics performing maintenance work. Dismantled parts are jointly inspected on screen in high-resolution, enabling appropriate order decisions to be made.

Impacted Areas & Business Value

- Added Value:
  - Greater operational efficiency and performance
  - Time and cost savings
  - Indirect positive environmental impact

#Operations **#ProcessControl** **#CustomerService**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability			●
Innovative Nature		●	
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- B2B
- B2C

#Edge **#VR** **#ML** **#Robotics**

Foxconn

5G Lights-Off Factory – Automation & Self-Maintenance and Production System

Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- Lights-off factory in Shenzhen (China) has been awarded the distinction of "Manufacturing Lighthouse" by the WEF. Foxconn Industrial Internet (Fii)'s lights-off factory utilizes numerous applications connected directly to a private network to enable several use cases and realize associated benefits. These include an automated optimization system for machine learning and AI devices, an intelligent self-maintenance & production monitoring system and real-time system.

Business Model & Key Actors

- Fii is developing an ultra-low latency 5G industrial private network. In the future, a 5G industrial private network will be enabled by mobile operators to facilitate high reliability and low latency data transmission.
- Key actors
  - Network equipment provider: Foxconn
  - System integrator: Huawei
  - Operator: /

Technical Architecture

- Industrial robots connected to the 4G industrial private network achieve latency below 100 milliseconds allowing for near real-time robot control and data access & feedback. Fii is developing an ultra-low latency 5G industrial private network to achieve real-time control, data access & feedback with latency as low as 1 millisecond. In addition, implementation of a Fii Factory Management Control System (FMCS) tracks energy consumption across the plant via IoT sensors.

Impacted Areas & Business Value

- Added Value:
  - Production efficiency increased by 30%
  - Inventory cycle reduced by 15%
  - Reduced labor costs compared to semi-automated process
  - Reduction of all forms of energy consumption leading to annualized savings of US$1.6M per facility

#Operations **#ProcessControl** **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#Edge** **#Robotics** **#IoT**

Porsche

5G-Accelerated Production Capabilities – Remote Production

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- How to drive the future of the automotive industry? A research partnership between Ericsson and Porsche is leveraging the power of 5G to accelerate production capabilities at Porsche's manufacturing production complex in Leipzig, Germany. The trial project is the first deployment of a private 5G network at any of Porsche's production complexes, heralding in a new remote production era for the high-performance car manufacturer.

Business Model & Key Actors

- Ericsson is working Porsche's smart factory and provide it with world leading 5G and Private Network products.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: /

Technical Architecture

- Ericsson's 5G SA network operates over a private frequency spectrum. The dedicated 5G network is piloted in the technology cell of Porsche's Macan body shop and enable the control of robotics in real time without cables. It also allows for the transmission of massive amounts of data between other on-site machines, production workers and vehicles through the secure, flexible and predictable transmission of signals in real time.

Impacted Areas & Business Value

- Added Value:
  - Increased worker safety
  - Faster production times
  - Reduced costs
  - Increased quality

#Operations **#Safety**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

B2B

B2C

#AI **#Edge** **#IoT**

MTU Aero Engines

5G Based Process Automation - Machine Vision for Real Time Quality Control

Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- The main challenge for MTU Aero Engines, as an aircraft engine manufacturer, include the critical need for maximum quality to ensure safety, and the difficulty of monitoring and controlling the process in real time. To this end, it has been experimenting with 5G-based production technology to make their operations more efficient. They test its applications on blade integrated disks (blisk), which are high-tech components used for jet engines. These are extremely complex and require the utmost accuracy to produce.

Business Model & Key Actors

- Ericsson and the Fraunhofer Institute for Production Technology have teamed up to explore and develop industrial applications of 5G.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: /

Technical Architecture

- The Blisk project shows the technical capabilities of 5G such as ultra-low latency close to 1 millisecond, which is vital for in-process, time-critical applications. Ericsson's 5G trial system operating on 3.5 GHz is connected to an acceleration sensor mounted directly on the blisk in the production machinery. The vibration spectrum is transmitted in real time via 5G to the evaluation system. The very low latency helps correlate the vibration to the tool's position and enable prompt adjustment of the production process.

Impacted Areas & Business Value

- Added Value:
  - Greater operational efficiency & Improved quality
  - Design process time reduced by 75%
  - Potential for annual cost savings up to €27M per factory
  - Potential for CO2 emissions reduction to 16M tons annually

#ProcessControl

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness		●	
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- **Ultra-reliable low latency comms.**
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#Edge** **#DigitalTwin**

GF Machining

5G-Powered Predictive Maintenance & Connected Tablets

Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- 5G-based predictive maintenance and connected tablets have been implemented at GF Machining's factory. In fact, key to the high quality of watches produced in Switzerland is accurate and high-speed metal milling. Excessive vibration is a real issue with milling processes, which results in poor milling leading to a high rejection rate. Therefore, predictive maintenance is of critical importance to GF Machining as it improves product quality by a large margin and reduces the failure rate by a significant degree.

Business Model & Key Actors

- Sunrise has established a joint 5G innovation center with Huawei to work on 5G enabled services. One of the first successes has been with GF Machining, who provide machining services for manufacturers in Switzerland, including watch companies.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: Sunrise

Technical Architecture

- The blade integration discs within milling machines have very high precision requirements, with a tolerance of only 1 to 10 microns. Combined with high milling speeds and acceleration of up to 1G, issues are quick to form. The low latency of 5G, combined with local Edge computing servers, is crucial to ensure that data from IoT sensors monitoring the milling machines can be processed as fast as possible to highlight any issues that require rectification.

Impacted Areas & Business Value

- Added Value:
  - Significant reduction of the failure rate of the milling process resulting in €30M of savings per plant

#Operations **#ProcessControl**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#Edge** **#IoT**

Ericsson

Wireless Factory Sustainability & Connectivity – Mix Basket of Solutions for Factories

Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- In an era of intense volatility due to shorter business and product lifecycles, manufacturing companies around the globe are under extreme pressure to reduce cost of operations. To do this, factories must leverage technology and digitalization to become more agile and efficient. To increase production efficiency and sustainability, Telia and Ericsson brought automated guided vehicles, augmented reality, and a huge number of sensors to life at Ericsson's manufacturing facility in Tallinn.

Business Model & Key Actors

- Telia and Ericsson jointly unveiled a new dedicated cellular network for Internet of Things (IoT) within the factory.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: Telia

Technical Architecture

- To make production more efficient and sustainable, Telia and Ericsson built a brand-new mobile network for the IoT (the Internet of Things). Ericsson's partner ABB is providing a fully automated flexible robot cell solution for the final assembly of 5G radios. The partnership will enable enhanced connected services, Industrial IoT and artificial intelligence technologies in the future.

Impacted Areas & Business Value

- Added Value:
  - Efficiency gains up to 25%
  - Average default detection time reduced by 15%
  - 10 to 20% of heating costs reduction (also results in lower CO2 emissions)
  - Increased worker safety

#Operations **#ProcessControl** **#Safety**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AR **#AGV** **#ML** **#IoT**

Schneider Electric Le Vaudreuil

AR Maintenance & Robot Guide for Remote Visits

Commercially Live
Pilot
Potential (Concept)

Start Year – 2021

Context

- Schneider Electric, a leader in digital transformation, energy management and automation, and Orange announced the first deployment of indoor 5G in the industrial sector in France. The 5G project will facilitate the convergence of Information and Operational Technologies (IT/OT) for comprehensive co-innovation approach. 5G help to synchronize in real time large amounts of data, which are key to boost performance, facilitate remote working, and ensure optimal production efficiencies.

Business Model & Key Actors

- Orange has deployed an indoor, private, virtualized network on experimental frequencies allocated by the Arcep. Nokia radio AirScale and core equipment has been selected.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: Orange

Technical Architecture

- Operators using the AOA application via their 5G-connected tablet film a machine and access information about its status and future maintenance that are hosted in the cloud in real time. Moreover, production data used by AOA are collected and processed in Schneider Electric's micro data center solutions, which locally power, cool and protect IT infrastructure. The performance of 5G makes it possible for very high-quality video to be used with minimal lag time in the virtual interactions between the visitor and the Schneider Electric guide that accompanies the robot.

Impacted Areas & Business Value

- Added Value:
  - AR: Better operational efficiency (reduce machine downtime, streamline maintenance operations, minimize human error)
  - Robots: Minimize travel time and costs, reduce carbon footprint, unique end user experience

#Operations **#ProcessControl** **#CustomerService**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

B2B

B2C

#AR **#Robotics** **#Cloud** **#AI**

Ypsomed

AR Quality Testing – Quality Assurance with AR

Commercially Live
Pilot
Potential (Concept)

Start Year – 2018

Context

- Ypsomed regularly conducts quality assurance tests. Until now, employees tested products at a test center and subsequently enter the data in the SAP in the office. Using augmented reality glasses, employees now check quality directly in the hall. This development has simplified and accelerated the quality assurance process immensely.

Business Model & Key Actors

- In this partnership Swisscom brings in mobile communication and software knowledge while Ypsomed bring in their domain knowledge. Together they are working on developing promising 5G solutions.
- Key actors
  - Network equipment provider: /
  - System integrator: /
  - Operator: Swisscom

Technical Architecture

- With Swisscom, Ypsomed has created a 5G test network and digitized the entire process chain, from the delivery of raw materials and product manufacture and through to provisioning and supply. For the first time, all the hardware and software components are being deployed through a 5G antenna. This includes the SAP S/4 software that is vital for industry, and data analysis applications.

Impacted Areas & Business Value

- Added Value:
  - Better worker safety
  - Greater processing speed
  - Increased quality

#Operations **#ProcessControl** **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#AR** **#IoT** **#ML**

Arcelor Mittal

5G Smart Steel Factory – Remote Maintenance & Autonomous Vehicles

Commercially Live
Pilot
Potential (Concept)

Start Year – 2021

Context

- Orange, Ericsson and ArcelorMittal France have developed a project to design industrial use cases adapted to ArcelorMittal's challenges and business requirements. This deployment meet the needs for industrial network performance, connecting workers, and operations on complex industrial sites. Targeted to different business operations (production, maintenance, logistics, etc), these use cases include better worker flexibility and mobility in different situations.

Business Model & Key Actors

- The project is based on Ericsson's technology leadership within 4G/5G private cellular networks suited for advanced industrial use cases and high-risk sites and Orange Business Services' integration and support expertise.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Orange
  - Operator: Orange

Technical Architecture

- The 5G private network provides extensive coverage (workers and machine operators can move freely with reliable connectivity anywhere on-site), high throughput and low latency (to meet the high-performance requirements), network slicing (to tailor services) and data security (to protect sensitive industrial data on-site).

Impacted Areas & Business Value

- Added Value:
  - Reinforced energy efficiency of the factory
  - Improved on-site worker safety

#Operations **#ProcessControl** **#Safety**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

B2B

B2C

#AR **#AI** **#AGV**

Huaheng

5G Smart Warehouse – Asset Tracking & Automated Guided Vehicles

Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- China Mobile have deployed the first 5G and MEC enabled AGV system, utilizing the province's first standalone 5G SA architecture. The 5G+MEC solution flexibly meet the requirements of multiple AGVs in operation at the same time. It allows for intensive scheduling of operations and the introduction of autonomous laser SLAM (Simultaneous Location And Mapping) navigation. Through the use of 5G, the numerous standardized AGV trolleys are coordinated, and the fleet can be expanded in the future.

Business Model & Key Actors

- China Mobile have deployed the system with Huawei and Huaheng to rollout the 5G SA+ MEC architecture across multiple plants, meaning that customer data does not leave the customers systems and E2E asset tracking and traceability can be securely established.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: China Mobile

Technical Architecture

- To enable multi-vehicle cooperative operation, 2-4 AGVs form a group for cooperative operation. One control center is able to control multiple vehicles and routing at the same time. Also, SLAM navigation generates huge amounts of data, as it allows each AGV to automatically recognize its surroundings and calculate its position using specialist equipment. 5G networking allows the SLAM data to be sent directly to the cloud for processing and return, reducing the cost of SA equipment for data processing on each vehicle.

Impacted Areas & Business Value

- Added Value:
  - Operational efficiency
  - Improved data protection
  - Reduced operational costs

#Operations

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#MEC **#SLAM** **#AGV** **#AI**

DHL

5G-Based Smart Supply Chain – Asset Tracking, E2E Traceability, Automated Guided Vehicles

Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- To DHL Supply Chain, the IoT is a critical piece of technology that enables better services for their customers and more efficient warehouse operations. The advent of wireless networks, including 5G has allowed DHL to innovate in their product offerings and introduce new use cases into their logistics management operations. This solution consists in the visualizations of the operations within a warehouse using heat-maps and other visualizations and reports.

Business Model & Key Actors

- DHL Supply Chain has established a lighthouse site at their Beringe warehouse facility in Germany. This facility is used to establish best practice and pilot new technologies and use cases before they are rolled out globally.
- Key actors
  - Network equipment provider: Cisco, Conduce
  - System integrator: Cisco, Conduce
  - Operator: /

Technical Architecture

- By gathering the indoor positioning of various connected assets, combined with data from the Warehouse Management System to understand what tasks are being allocated to whom, DHL is able to build a real-time map of activities within the warehouse. The system is also able to give accurate data on response rates, record any incidents and measure overall utilization of equipment and space.

Impacted Areas & Business Value

- Added Value:
  - Operational & logistical efficiency
  - Improved health & safety

#Operations **#CustomerService** **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

B2B

B2C

#AI **#Edge** **#IoT**

Ypsomed

5G-Automated Localization Tracking - Digitalized Good Tracking Throughout Production Chain

Commercially Live
Pilot
Potential (Concept)

Start Year – 2018

Context

- Ypsomed's machines produce, for example, insulin pens for people with diabetes. These ballpoint pen-sized syringes undergo an automated process, are localized in real time during the production steps and are available in SAP. Sensors on the crates and a local 5G Mobile Edge Cloud make this possible at Ypsomed. If a product is not in the correct location, the system will raise an alarm. A formerly tedious process which involved scanning bar codes now runs automatically and in real time.

Business Model & Key Actors

- In this partnership Swisscom brings in mobile communication knowledge and software knowledge while Ypsomed bring in their domain knowledge. Together they are working on developing promising 5G solutions.
- Key actors
  - Network equipment provider: /
  - System integrator: Swisscom
  - Operator: Swisscom

Technical Architecture

- With Swisscom, Ypsomed has created a 5G test network and digitized the entire process chain, from the delivery of raw materials and product manufacture and through to provisioning and supply. For the first time, all the hardware and software components are being deployed through a 5G antenna. This includes the SAP S/4 software that is vital for industry, and data analysis applications.

Impacted Areas & Business Value

- Added Value:
  - Shorter lead time leading to greater operational efficiency
  - Reduced risk of failure in the production chain

#Operations #ProcessControl

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- B2B
- B2C

#AI #ML #IoT

Ypsomed

Predictive Machine Management – Real Time Data Analysis of Production Process

Commercially Live
Pilot
Potential (Concept)

Start Year – 2018

Context

- Ypsomed's machines must run without interruption to produce to as high a quality and as cost-effectively as possible. Owing to a software solution implemented in the local Mobile Edge Cloud, 5G generates huge data volumes on the production machines in real time. Predictive management can also be carried out by analyzing the data: for example, it is possible to predict when a particular part of a production plant will need to be replaced or repaired. This can prevent failures and makes it possible to schedule replacement or revision of a machine.

Business Model & Key Actors

- In this partnership Swisscom brings in mobile communication knowledge and software knowledge while Ypsomed bring in their domain knowledge. Together they are working on developing promising 5G solutions.
- Key actors
  - Network equipment provider: /
  - System integrator: Swisscom
  - Operator: Swisscom

Technical Architecture

- With Swisscom, Ypsomed has created a 5G test network and digitized the entire process chain, from the delivery of raw materials and product manufacture and through to provisioning and supply. For the first time, all the hardware and software components are being deployed through a 5G antenna. This includes the SAP S/4 software that is vital for industry, and data analysis applications.

Impacted Areas & Business Value

- Added Value:
  - Efficient asset monitoring and maintenance scheduling
  - Prevent risk of failure in the production chain

#Operations **#ProcessControl**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#ML** **#IoT**

Nokia

Factory of the Future – Virtualization, Robots & Automation

Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- Nokia factory in Oulu (Finland) manufactures and designs the production processes for a variety of telecommunication products like base stations that, once optimized, can be transferred and scaled to other production facilities worldwide. With new products pouring in for testing every month, including future 5G products, changes to the factory layout are constant and flexibility is paramount. Increasing the level of automation was thus a key objective.

Business Model & Key Actors

- Nokia's 5G "factory of the future" in Oulu is powered by Nokia Digital Automation Cloud, a platform used to digitalize its own pre-production facility.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: Telia

Technical Architecture

- The solution leverages a private (4.9G/LTE) wireless network for secure, reliable connectivity for all assets within and outside the factory. It also relies on IoT analytics running on Edge cloud, as well as a real-time digital twin of operations data.

Impacted Areas & Business Value

- Added Value:
  - Productivity gains of 30%
  - 50% savings in time of product delivery to market
  - Annual cost savings of millions of euros

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#DigitalTwin **#Edge** **#Robotics** **#IoT**

Bosch

5G Factory – Machine & Collision Detection Sensors

Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- Time is money in the manufacturing process. 5G private networks, together with 5G-enabled technologies such as the Internet of Things, can provide a crucial platform for continuous optimization of machine performance, while avoiding slow and costly infrastructural changes. The Bosch factory has seized this 5G opportunity by incorporating a sensor system for machine status and collision detection.

Business Model & Key Actors

- Worcester Bosch has launched the 5G factory using a 5G private network and mobile edge computing infrastructure provided by Ericsson and managed by BT.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: BT

Technical Architecture

- The factory uses 5G to run real-time machine sensors, allowing them to address problems on the production line before they happen. Another benefit has been the installation of a network of collision detection sensors, making the factory and its products much safer for on-the-ground employees and consumers alike.

Impacted Areas & Business Value

- Added Value:
  - Optimized machine performance
  - Increased output (+2%)
  - Higher factory & product safety

#Operations **#ProcessControl**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness		●	
Sustainability			●
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#Edge **#IoT** **#ML** **#AI**

NTT DoCoMo

5G in Smart Factories – Autonomous Robots & AI Coaching

Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- As background noise from machines and the movement of people have the potential to interfere with wireless communications, the project verify the reliability and stability of 5G technology deployed by conducting radio wave measurements and transmission experiments. Nokia, DOCOMO and OMRON established the feasibility of the concept of a layout-free production line with Autonomous Mobile Robots (AMRs), as well as to leverage 5G connectivity for real-time coaching using AI/IoT.

Business Model & Key Actors

- Nokia, NTT DOCOMO, INC. and OMRON Corporation have agreed to conduct joint field trials using 5G at their plants and other production sites.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: NTT DoCoMo

Technical Architecture

- Nokia provides Nokia Digital Automation Cloud - an industrial-grade digitalization service platform that provides a private 5G wireless network and edge computing capabilities. OMRON provides factory automation components such as AMRs (Autonomous Mobile Robots), sensors and controllers (PLC), control technology, expertise on the manufacturing industry, and the factory site for conducting the trials. NTT DOCOMO runs the trial.

Impacted Areas & Business Value

- Added Value:
  - Higher productivity thanks to automation and accuracy of robotics
  - Improve technicians' trainings by detection and analysis in differences of motion

#Operations **#HR**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#IoT** **#ML** **#Robotics**

Ypsomed

Mobile Edge Cloud Stored Machines - Machine Virtualization

Commercially Live
Pilot
Potential (Concept)
Start Year – 2018

Context

- Until now at Ypsomed, each machine has had its own integrated computer. In a production environment networked via 5G, the software no longer runs in the machine, but is virtualized on the Mobile Edge Cloud. This enables employees to gain access to every machine via a tablet and move freely in the production hall. Ypsomed therefore saves on hardware, software and maintenance costs.

Business Model & Key Actors

- In this partnership Swisscom brings in mobile communication knowledge and software knowledge while Ypsomed bring in their domain knowledge. Together they are working on developing promising 5G solutions.
- Key actors
  - Network equipment provider: /
  - System integrator: Swisscom
  - Operator: Swisscom

Technical Architecture

- With Swisscom, Ypsomed has created a 5G test network and digitized the entire process chain, from the delivery of raw materials and product manufacture and through to provisioning and supply. For the first time, all the hardware and software components are being deployed through a 5G antenna. This includes the SAP S/4 software that is vital for industry, and data analysis applications.

Impacted Areas & Business Value

- Added Value:
  - Greater productivity to centralized access to machines
  - Reduced hardware, software, and maintenance costs

#Operations **#ProcessControl**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IoT **#Edge** **#Cloud**

Ericsson

5G-Automated Factory – Connected Screwdrivers

Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- Ericsson factory harnesses the data generated through connecting everything from screwdrivers to entire warehousing systems with Industrial IoT and NB IoT. Until now, this has been a manual procedure performed periodically and documented in handwritten logs. With connected screwdrivers, the factory is able to replace manual tracking of tool usage data with an automated solution. This includes the first modular-designed automatic assembly line for 5G radios.

Business Model & Key Actors

- China Mobile and Ericsson enabled automation by applying cellular IoT technology. Using connected tools such as screwdrivers, the world's first cellular IoT-based trial took place at Ericsson's site in Nanjing.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: China Mobile

Technical Architecture

- There are approximately 1,000 high-precision screwdrivers in the factory that require routine calibration and lubrication based on utilization times. The high-precision tools were fitted with real-time motion sensors that were attached to NB-IoT modules. The data runs via a cellular IoT network over the company's private cloud and back-end systems, which make automatic calculations and intelligent analyses of the collected data.

Impacted Areas & Business Value

- Added Value:
  - Increased efficiency, accuracy & quality in the production line
  - Significant reduction in OPEX (Manual work cut by 50% - Up to 100%)
  - Better monitoring of the resources

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability			●
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IoT **#ML** **#AI** **#Analytics**

BMW

Dual-Slice Solution for Factory - Hybrid Private 5G Networks

Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- In 2020, Ericsson partnered with Deutsche Telekom to deploy a combination of private and public 5G networks at a new BMW campus network site in Leipzig, Germany. Firstly, it consists of a private 5G mobile communications network for plant operations and staff. This ensures a perfect connection even for terminal devices that are not allowed to transmit in the private network. For example, smartphones of customers or suppliers.

Business Model & Key Actors

- With Ericsson as network supplier, Deutsche Telekom has deployed its innovative campus network solution – a combination of private and public networks – in a new campus network site in Leipzig, the fourth one the German service provider has set up in Europe.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: Deutsche Telekom

Technical Architecture

- The project implemented in the BMW factory, is a unique combination of private and public networks called a "dual-slice" solution and consists of a private mobile communications network for plant operations and staff, combined with the public network transmitting the same signal strength for devices that are not allowed to transmit in the private network.

Impacted Areas & Business Value

- Added Value:
  - Stronger operational efficiency
  - Greater control & reliability

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IoT **#Edge** **#AI**

Konecranes's Hyvinkää

5G R&D Solution Development - R&D Trials for Smart Factory

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- The 5G network enable Konecranes to research and develop digitalized factory and port solutions that leverage 5G's high bandwidth and low latency for increased productivity, improved efficiency, and enhanced safety. The 5G network support trials across Konecranes operations, incorporating its smart factory, research and development facilities, and test cranes. One use case example is the deployment of high-resolution wireless cameras to improve load handling safety, site security and operational integrity.

Business Model & Key Actors

- Nokia and Edzcom deploy 5G SA private wireless network to support Konecranes' advanced R&D work; the collaboration builds on existing Konecranes LTE private wireless investment.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Edzcom
  - Operator: Edzcom

Technical Architecture

- Edzcom deployed a private wireless and application platform based on the Nokia Digital Automation Cloud (DAC). Compact and easy to deploy, Nokia DAC comprises network and user equipment, a cloud-based operation monitoring system and industrial connectors that ease standard and industry-specific protocol connectivity. It also features a catalog of applications, that seamlessly integrates ruggedized routers, handhelds, and other wireless devices.

Impacted Areas & Business Value

- Added Value:
  - Increased worker safety
  - Faster production times
  - Reduced costs
  - Increased quality

#Operations **#ProcessControl** **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability			●
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IoT **#AI** **#Edge** **#Cloud**

HEALTHCARE & LIFE SCIENCES

Belgium spends 10% of its GDP on health care – placing it fourth among EU countries – and 76.8% of this health care expenditure is financed by the government.

NATIONAL ACCOUNTS

Value Added *(Euro, Millions)*
27,455

Labour input *(Persons, thousand)*
658

Gross Fixed Capital Formation *(Euro, Millions)*
4,603

Gross Fixed Assets *(Euro, Millions)*
79,332

CHALLENGES

Robustness of ability to respond in crisis times

The circumstances of a global pandemic crisis, the shortages of human resources and the vulnerability of supply chains undermine the capacity to meet the growing demand for urgent healthcare services.

Digitalization of the care economy

A critical enabler to improve capacity, productivity, deliver significant reductions in travel-related emissions (green care), enhance the patient experience and empower interoperability.

Demographic changes

Population growth and aging trends are leading to an increasing demand for innovative technologies.

Growing competition

The competitive environment is intensifying due to lower barriers to entry, the arrival of emerging countries with generic drugs and access to cheaper technologies.

TRENDS

103 General hospitals in 2019, with a turnover of around 19 billions euros

127 Triage and testing centers have been set up during the Covid-19 crisis, and 5 million visitors went to the online portal over a period of 7 months

526,054 Primary emergency assistance interventions were recorded during the same period

HEALTHCARE & LIFE SCIENCES ECOSYSTEM

End Service Providers (Hospitals & Healthcare Facilities)

Producers (Pharmaceuticals & Biotech, Medical Devices Manufacturers)

Fiscal Intermediaries (Insurers, Hmos)

Purchasers (Government, Employees, Individuals)

5G use cases in each area of the ecosystem

- 5G Smart Hospital
- World Class Smart Hospital
- 5G Remote Brain Surgery
- 5G Based Remote Surgery
- 5G eHealth

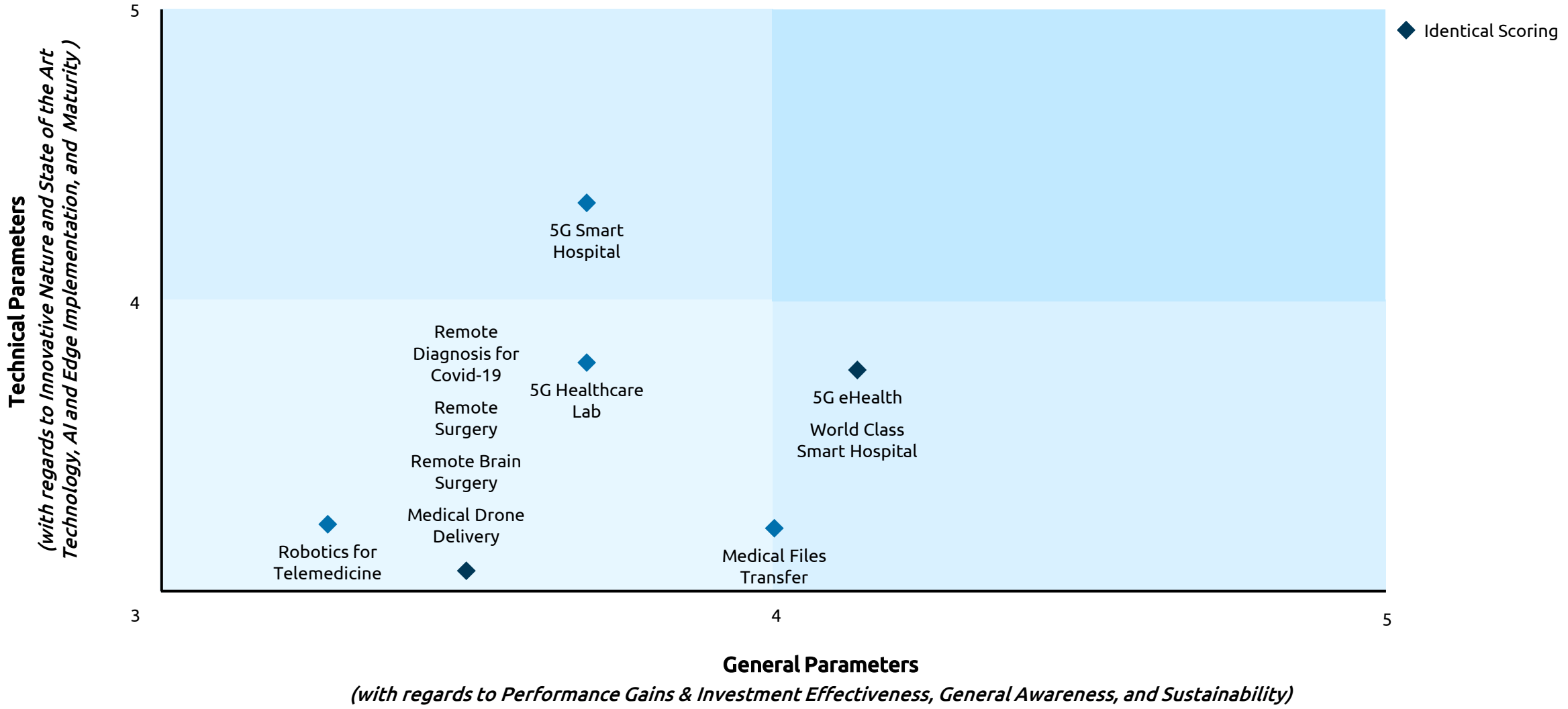
- Remote Diagnosis for Covid-19
- Smart 5G Healthcare lab
- Medical Drone Delivery
- 5G Robotics for Telemedicine

- Medical Files Transfer

- Self Analysis*

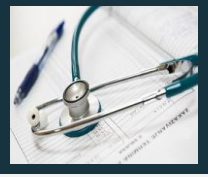
** Potential use case of 5G for this type of actor, but not yet observed*

HEALTHCARE & LIFE SCIENCES USE CASES MAPPING



Samsung Medical Center (SMC)

5G Smart Hospital - Smart Care Solutions



Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- KT Corp built an enterprise-dedicated 5G network at the Samsung Medical Center (SMC), created service environments in operating and proton therapy rooms, and conducted a test operation - for better medical service. These services include digital diagnostic pathology, access to proton therapy information, teaching surgery, an AI-enabled care for in-patients, and an autonomous robot for an operating room.

Business Model & Key Actors

- KT Corps and the SMC have jointly developed an innovative, 5G-powered medical service as an initial step to establishing a 5G smart hospital.
- Key actors
  - Network equipment provider: KT Corp
  - System integrator: KT Corp
  - Operator: KT Corp

Technical Architecture

- 5G features enable speedy and uninterrupted access to pathological data obtained during surgery, as well as surgeons in operating room to teach a large group of medical trainees in a separate lecture room (using sync cams, and massive connectivity minimizes disruption and latency in data exchange with robots and terminals). Moreover, Smart Care Giver, the AI-assisted system of in-patient care, enables patients to control their hospital room with a voice command.

Impacted Areas & Business Value

- Added Value:
  - Improved operational efficiency
  - Greater convenience for all medical customers - patients, medical staff and visitors

#Operations **#CustomerService** **#HR**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

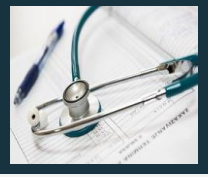
B2B

B2C

#IoT **#AI** **#Robotics** **#AR/VR**

Siriraj Hospital

5G World Class Smart Hospital - Cross-Solutions for Medical Services



Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- The "Siriraj World Class 5G Smart Hospital" deliver a more efficient and convenient experience to patients by introducing technologies such as 5G, cloud, and artificial intelligence. Meanwhile, Siriraj Hospital and Huawei will establish a Joint Innovation Lab to incubate 5G applications that will be promoted nationwide from 2022. Currently, the two organizations are involved in portable medical boxes, unmanned vehicle, medical carts, and smart hospital beds using 5G technology.

Business Model & Key Actors

- The Office of the NBTC and Huawei jointly launched the 5G smart hospital project in the ASEAN region to deliver a more efficient and convenient experience to patients.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: /

Technical Architecture

- Siriraj Hospital and Huawei Thailand launched 5G self-driving vehicles for contactless delivery of medical supplies. The project comprises nine sub-projects, namely a smart emergency medical service, smart emergency rooms, pathological diagnosis system with 5G and AI, an AI platform for non-communicable diseases, smart inventory management, a permission-based block chain for personal health records, smart logistics with a 5G self-driving car, multi-access edge computing and a hybrid cloud system.

Impacted Areas & Business Value

- Added Value:
  - Reduced processes for medical personnel
  - Decreased overall risk
  - Improved effectiveness & efficacy of healthcare for patients

#Operations **#CustomerService**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

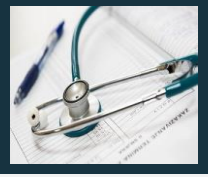
Use Case Type

- **B2B**
- **B2C**

#IoT **#AI** **#Cloud**

PLA General Hospital

5G Remote Brain Surgery - Tele-monitored Operation Through Remote Robotic Control



Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- A patient suffering from Parkinson's disease has received China's first 5G-based remote surgery with a deep brain stimulation (DBS) implant. The operation started at 9:00 a.m. in Sanya City, manipulating the surgical instruments 3,000 kilometers away in Beijing with micron precision on a computer through a 5G network, and successfully implanted the DBS at the optimal target site.

Business Model & Key Actors

- With help from China Mobile and Chinese technology giant Huawei, China's PLA General Hospital (PLAGH) performed the operation using 5G technology.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: China Mobile

Technical Architecture

- The patient, affected by Parkinson's syndrome, required surgery but was unable to travel. The doctor who carried out the operation was alternating between multiple hospitals at a considerable distance from each other. He was, however, able to take care of this patient during his rotation via a robotic arm. The 5G network has solved problems like video lag and remote-control delay experienced under the 4G network, ensuring a nearly real-time operation.

Impacted Areas & Business Value

- Added Value:
  - Completing operations which were previously difficult to finish at the grassroots-level hospitals
  - Improved quality of life
  - Positive environmental impact (reduced carbon emissions)

#Operations **#CustomerService**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- **Ultra-reliable low latency comms.**
- Massive machine-type comms.

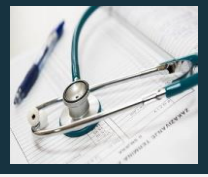
#IoT **#AI** **#Robotics**

Use Case Type

- **B2B**
- **B2C**

Beijing Jishuitan Hospital

5G Remote Surgery - Remote Robotic Medical Intervention



Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- While telecommunications providers are encouraging the development of industrial applications for 5G, remote surgery promises to be a valuable use of the wireless networking technology and robotics. Multiple trials have been conducted in China in terms of orthopedic surgery, percutaneous coronary interventions, dental procedures and other remote medical interventions.

Business Model & Key Actors

- Beijing Jishuitan Hospital has deployed in collaboration with actors such as Huawei, China Mobile, China Telecom.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: China Mobile, China Telecom

Technical Architecture

- Doctors can perform interventions via images and videos in real time thanks to extra-minimal time lags of 5G technology and via the help of remote-controlled robots or equipped with AI mastering certain procedures or, for the doctor in charge, by providing instructions to his peers via indications drawn on a screen.

Impacted Areas & Business Value

- Added Value:
  - Increased capacity to provide care
  - Positive environmental impact (reduced carbon emissions)

#Operations **#CustomerService**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

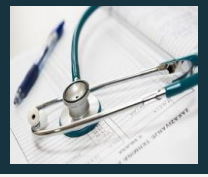
Use Case Type

- **B2B**
- **B2C**

#IoT **#AI** **#Robotics**

Oulu University Hospital

5G eHealth – Smart Hospital



Commercially Live
Pilot
Potential (Concept)

Start Year – 2018

Context

- Efficient logistics is critical to any modern hospital. At the Oulu University Hospital, Nokia deployed its Digital Automation Cloud (DAC), including high-accuracy indoor positioning capability. This helps staff locate and track beds, wheelchairs, and other equipment in real time. They also deployed a mobile robots to assist in certain tasks; e.g., delivering medical equipment, medicine from the pharmacies, guiding people to the correct waiting areas, etc.

Business Model & Key Actors

- Nokia is taking part in a multi-partner research project that seeks to improve patient care and lower costs by making a fully 5G connected hospital a reality.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: /

Technical Architecture

- The Nokia Future X Architecture for Healthcare provides a dedicated high-performance network to connect people, sensors, machines, and video monitors for better patient outcomes.

Impacted Areas & Business Value

- Added Value:
  - Greater productivity per worker via less time waster in unskilled tasks
  - Significant reduction in medicine errors by robotizing tasks
  - Faster, more precise, and better quality of service for the patient

#Operations

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

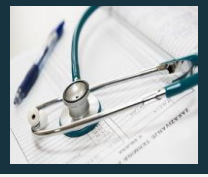
Use Case Type

- **B2B**
- **B2C**

#IoT **#AI** **#Robotics** **#Analytics**

West China Hospital & Chengdu Public Health Clinic Center of Sichuan Uni

5G Remote Diagnosis for Covid-19 - Remote Consultation For Coronavirus



Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- ZTE Corporation and China Telecom have realized a 5G remote diagnosis of new coronavirus pneumonia backed up with the latest 5G technology. The equipment was used to create a reliable indoor 5G network and support remote video consultations. Using 5G to connect doctors with patients mitigated the risks associated with treating deadly diseases without sacrificing the speed and quality of care.

Business Model & Key Actors

- Chinese networking equipment maker ZTE and network operator China Telecom facilitated China's remote diagnosis of the coronavirus, by using a 5G network.
- Key actors
  - Network equipment provider: ZTE
  - System integrator: ZTE
  - Operator: China Telecom

Technical Architecture

- ZTE supplied, installed, and optimized both outdoor and indoor 5G networking and other communications equipment for the West China Hospital of Sichuan University. It has rolled out its CPE equipment to commission 5G services by means of outdoor 5G signals while constructing indoor coverage points. In addition, 5G indoor base stations were built and interconnected, and the conference room in West China Hospital was first connected to the remote diagnosis and treatment system.

Impacted Areas & Business Value

- Added Value:
  - Mitigation of contamination risks
  - Delivery of an efficient, qualitative and fast care service

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge			●
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

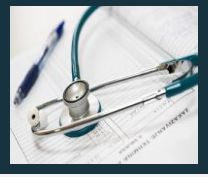
Use Case Type

- **B2B**
- **B2C**

#IoT **#AI** **#Analytics**

Emory Healthcare Innovation Hub (EHIH)

Smart 5G Healthcare Lab



Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- The Emory Healthcare Innovation Hub (EHIH) is a healthcare advancement and commercialization program committed to improving the patient care and provider experience. The addition of Verizon 5G gives researchers the ability to explore solutions such as connected ambulances, robotic-assisted surgery, remote physical therapy and next-generation medical imaging.

Business Model & Key Actors

- Verizon offer EHIH with 5G as well as network and security services, project management, professional consulting services and managed infrastructure and sit on the Emory Hub Executive Advisory Board.
- Key actors
  - Network equipment provider: Verizon
  - System integrator: Verizon
  - Operator: Verizon

Technical Architecture

- The massive bandwidth, super-fast speeds and ultra-low latency of Verizon's 5G Ultra Wideband network combined with mobile edge computing allow the hub to explore augmented and virtual reality (AR/VR) applications for medical training, enable telemedicine and remote patient monitoring, and provide point of care diagnostic and imaging systems from the ambulance to the ER.

Impacted Areas & Business Value

- Added Value:
  - Greater operational efficiency & experience for care providers
  - Better patient experience thanks to innovative solutions

#Operations **#CustomerService** **#HR**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

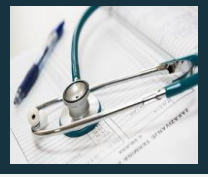
#IoT **#Edge** **#AR/VR**

Use Case Type

- **B2B**
- **B2C**

Skyfarer

Medical Drone Delivery - Smarter, Faster, Safer And Greener Supply Chains



Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- The New Midlands-based consortium forms the first medical drone delivery network of this type in the heart of England, with plans to create a national infrastructure enabling same day delivery with autonomous drones in the future. One of the key use cases identified, is the use of drones for transporting organs and blood supplies. The drones will be used to transport acute medicine and lightweight PPE from pharmacies to care homes.

Business Model & Key Actors

- A consortium led by Skyfarer (drone logistics operator) alongside O2 (telecoms), Cranfield University, Altitude Angel (traffic management solutions provider) and Phoenix Wings (drone manufacturer).
- Key actors
  - Network equipment provider: O2
  - System integrator: /
  - Operator: /

Technical Architecture

- N/A

Impacted Areas & Business Value

- Added Value:
  - Speed up response time for emergency situations
  - Quicker turnaround times for medical supplies
  - Reduced carbon emissions

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IoT **#UAV** **#Analytics**

Instituto Valenciano de Oncologia (IVO)

5G Robotics for Telemedicine - Robotic Arm For Medical Diagnosis

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- The possibilities offered by 5G technology in the healthcare sector make it possible to bring specialized diagnostics closer to the patient, remotely and thus avoiding inconvenient travel. One of the pilots of the Spanish National 5G Plan includes a robot arm that can detect skin cancer remotely through multispectral images processed with technology from the Ainia technology center.

Business Model & Key Actors

- Orange, Huawei, iTeam and CFZ Cobots join forces to help the Valencian Institute of Oncology (IVO), which will try to detect skin cancer remotely.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: iTeam
  - Operator: Orange

Technical Architecture

- The technology is based on a multispectral camera that allows the skin to be analyzed for signs of disease. The robot helps move the camera, which is very heavy. After analyzing the images, the dermatologist makes a diagnosis based on what he sees. The project also includes other cameras to view the images in more detail and to simulate the volume in three dimensions in a capture.

Impacted Areas & Business Value

- Added Value:
  - Real-time diagnostics
  - Increase in the number of examinations/day
  - No discomfort due to biopsy
  - Specialist service for peripheral populations
  - Less travel positively impacting environment

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IoT **#Robotics** **#Video**

Austin Cancer Center

Medical Files Transfer - Connected Diagnostic Devices

Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- MRI, CAT, or PET scans and other image machines are typically very large files, which often need to be sent to a specialist for review. When the network is low on bandwidth, the transmission may take a long time or not be successful. This means the patient waits even longer for treatment and providers can see fewer patients in the same amount of time. Adding a high-speed 5G network to existing architectures can help quickly and reliably transport huge data files of medical imagery, which can improve both access to care and the quality of care.

Business Model & Key Actors

- AT&T and Austin Cancer Center, are leveraging 5G for quickly transmitting large imaging files.
- Key actors
  - Network equipment provider: AT&T
  - System integrator: AT&T
  - Operator: AT&T

Technical Architecture

- AT&T provided the 5G mobility network for quickly transmitting large imaging files; it can leverage quick image transfer from diagnosis center to the doctor for quicker analysis. The low latency and high data rate of 5G network help in quicker attention to the patients. As soon as the patient leaves the scanner, the study is already on its way. It's beneficial to doctors because they can get the results that they need quicker.

Impacted Areas & Business Value

- Added Value:
  - Faster diagnosis and treatment
  - Improved business processes
  - Reduced network costs

#Operations **#CustomerService**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability			●
Innovative Nature		●	
AI & Edge			●
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#5GNetwork

TRANSPORTATION & LOGISTICS

Belgium is a central location for transport and logistics because of its geographical position, its infrastructure, its qualified workforce and its IT opportunities.

NATIONAL ACCOUNTS

Value Added *(Euro, Millions)*
22,532

Labour input *(Persons, thousand)*
267

Gross Fixed Capital Formation *(Euro, Millions)*
8,783

Gross Fixed Assets *(Euro, Millions)*
245,124

CHALLENGES

Re-thinking economies of scale solutions

Tariff wars demonstrating the vulnerability of supply chains and highlighting the willingness to relocalize and regionalize, reinforced by the Covid-19 crisis.

Digitalization of the industry

An extensive transformation of the sector is underway to improve performance, profitability and safety.

Changing consumption behaviors and demand

Growing significance of e-commerce and of digital freight platforms (tracking) crossed with urbanization causing a demand for smaller vehicles adapted to densely populated cities.

Stricter emission regulations and corporate green initiatives

The worldwide challenge of climate protection requires to move towards carbon neutral solutions.

TRENDS

2nd Position for the port of Antwerp, which is the second largest European port and the fourth largest in the world.

3rd Position for Belgium in the Logistics Performance Index (LDI) global ranking carried out by the World Bank in 2018.

>300km This is the distance that separates Belgium from Paris, London, Amsterdam and Frankfurt, allowing quick and easy interactions via roads, waterways, railways and airports for both passenger and freight traffic

TRANSPORTATION & LOGISTICS ECOSYSTEM

Public Transport

Warehouse Management & Logistics

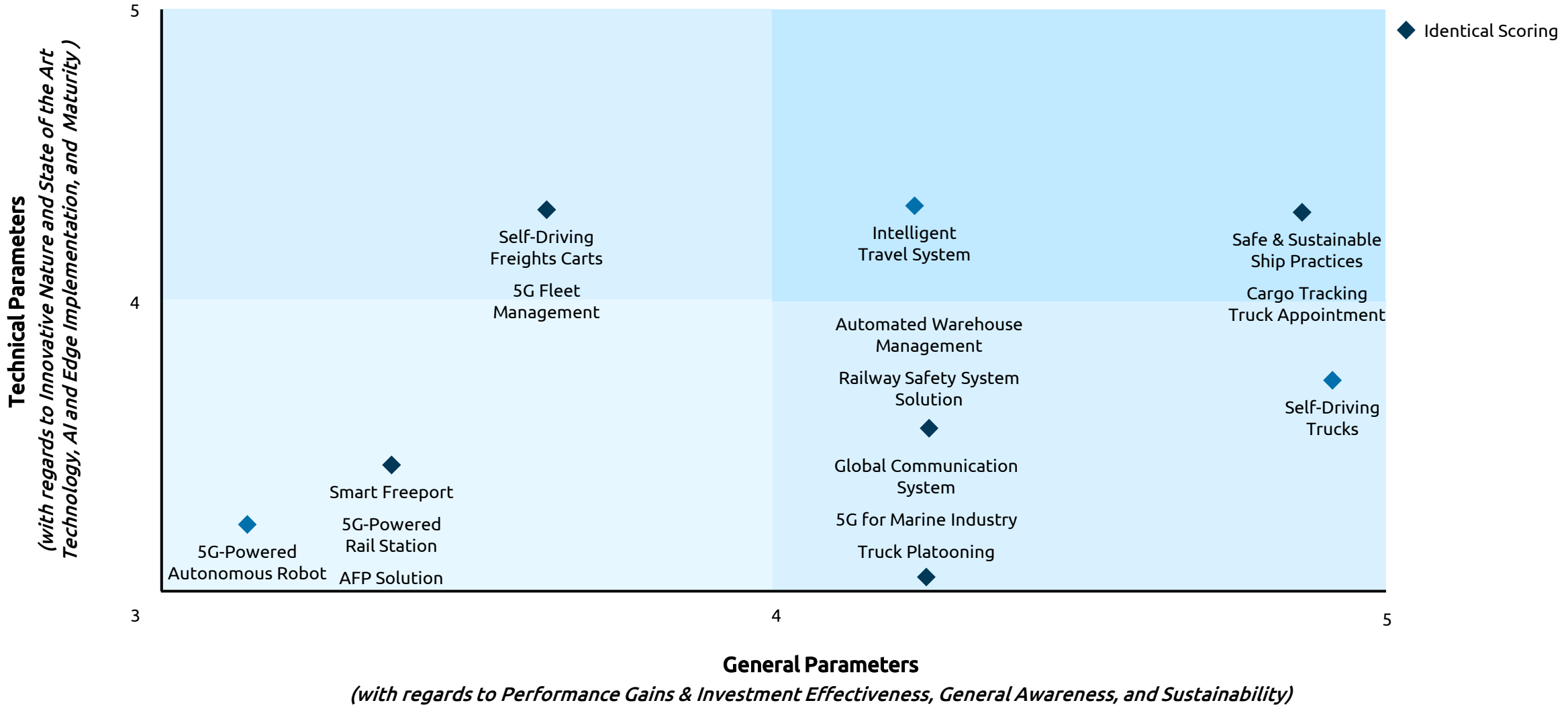
Traffic Management & Monitoring

Safety & Security

5G use cases in each area of the ecosystem

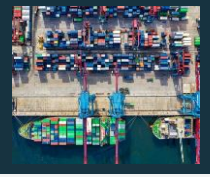
- 5G-Powered Autonomous Robot
- 5G-Powered Rail Station
- Global Railway Communication System
- 5G-Automated Warehouse Management
- Automated Factory Parking (AFP) Solution
- 5G Fleet Management
- Intelligent Travel System
- 5G-Controled & Monitored Truck Platooning
- 5G Smart Freeport
- 5G-Controlled Corridors for Cargo Tracking Truck Appointment
- 5G Self-Driving Trucks
- 5G Self-Driving Freight Carts
- 5G for Marine Industry
- 5G for Safe & Sustainable Ship Practices
- Railway Safety System Solution

TRANSPORTATION & LOGISTICS USE CASES MAPPING



Helsinki Airport

5G-Powered Autonomous Robot - Automated Robot Carrying Out Service Tasks



Commercially Live
Pilot
Potential (Concept)

Start Year – 2018

Context

- Finavia and Telia start explored the possibilities of using 5G in airport operations and bringing new kinds of experiences to passengers. To this end, they enabled Helsinki airport with a 5G robot operating in the non-Schengen area of T2 terminal. Telia and Finavia studied, how the passengers and the airport personnel react and interact with an autonomous robot carrying out service tasks.

Business Model & Key Actors

- Telia has launched a 5G network at the Helsinki Airport. The project means that Finavia was Telia's first customer using the commercial 5G network in Finland.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Finavia
  - Operator: Telia

Technical Architecture

- The data transmission and control of the robot was carried over a 5G base station at the airport. The network, based on technology by Nokia, utilized the 28 GHz frequency band, the higher frequency band allocated for 5G. This was the first time in Finland that so called millimeter waves were used for 5G in a public use case.

Impacted Areas & Business Value

- Added Value:
  - Better customer experience
  - Higher security
  - Better fluency of services

#Operations **#CustomerService**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

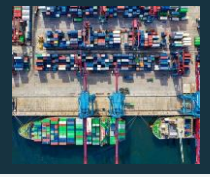
Use Case Type

- **B2B**
- **B2C**

#AI **#Robotics**

Shanghai Hongqiao Railway Station

5G-Powered Rail Station - 5G Digital Indoor System for Intelligent Travel Experience



Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- Shanghai Railway Station is one of Asia's busiest hubs in terms of passenger throughput. It handles over 60 million passengers every year, with over 330,000 people each day during peak seasons. With the application of the 5G DIS, the railway stations of the future is able to meet passenger demands for high-speed connectivity and mobile payments anytime and anywhere. These stations also support services including 4K HD video calls and multi-way, ultra-HD video uploading.

Business Model & Key Actors

- China Mobile and Huawei launched a 5G network in Shanghai's Hongqiao Railway Station, making it the first-ever railway station to incorporate a 5G digital indoor system (DIS).
- Key actors
  - Network equipment provider: Huawei
  - System integrator: /
  - Operator: China Mobile

Technical Architecture

- At the launch event, China Mobile Shanghai and Huawei demonstrated a peak rate of 1.2 Gbps, enabled by the 5G DIS. This means that passengers can log into a network supported by the system and download a 2 GB high-definition film in less than 20 seconds. Passengers are able to enjoy a seamless entertainment experience as they wait for, board, and ride their trains.

Impacted Areas & Business Value

- Added Value:
  - Satisfy changing demand (i.e., meet large connectivity demand)

#Operations #CustomerService

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability			●
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

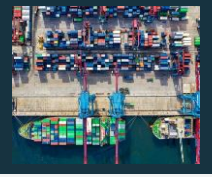
#IoT #DIS #AR/VR #WiFi

Use Case Type

- B2B
- B2C

European Rail Operators (DB,SNCF,SBB,OBB and IP)

Global Railway Communication System with 5G - Connected Rail Networks



Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- The Future Railway Mobile Communication System (FRMCS) is an umbrella standard covering all future rail use cases requiring a mobile communication system. The low latency that 5G offers allows information to be transmitted between vehicles and infrastructure in real time. A high level of connectivity is a prerequisite for handling the increasing data exchange that the digitization of the railway system entails, e.g. through automated driving or the optimized scheduling of trains in real time.

Business Model & Key Actors

- The 5G Rail Consortium, which brings together railway operators and telcos players, is working on prototyping the entire FRMCS ecosystem starting in France and Germany.
- Key actors
  - Network equipment provider: Nokia, Kontron, Alstom, Thales, Siemens, CAF, Teleste
  - System integrator: /
  - Operator: /

Technical Architecture

- FRENCH National Railways (SNCF) has signed an agreement with Nokia to develop a 5G laboratory for rail and non-rail uses and to prepare for the switch from GSM-R to the FRMCS. SNCF and Nokia will evaluate FRMCS applications in the laboratory and out in the field. Infrastructure manager SNCF Network and SNCF's innovation and research department will be closely involved in the project.

Impacted Areas & Business Value

- Added Value:
  - Higher reliability in railway services
  - Greater capacity on existing rail networks
  - Optimization of system costs

#Operations

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge			●
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

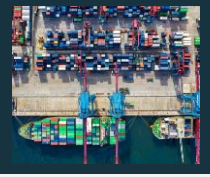
Use Case Type

- **B2B**
- **B2C**

#AI **#Edge**

Port of Livorno

5G-Automated Warehouse Management - Remote Control & Automated Cargo Handling, Monitoring And Tracking Systems Management



Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- The use case relies on a full spectrum of cargo security monitoring and tracking abilities throughout the supply chain to all stakeholders (including shippers, consignors, logistics providers and customs authorities This is accomplished through RFID tags and various IoT sensors to track the health and movement of cargo. The port of Livorno could achieve €2.5M savings per year through optimized vessel berthing and 25% improvement in productivity through remotely controlled gantry and quay cranes.

Business Model & Key Actors

- As part of the EU Horizon 2020, TIM, Authority Port of Livorno, CNIT, and FEEM, Ericsson is enabling sustainable growth in ports with 5G, the port is currently subject to a research innovation action project named COREALIS.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: TIM

Technical Architecture

- The trial involves a 5G-based control module for managing general cargo. It performs real-time control of loading/unloading operations, collecting data via yard vehicles and implanted sensors (e.g., LIDAR, WDR cameras and tablets), and making operating decisions based on real-time analytical processing. The instantiation of a pervasive 5G network in a container terminal at the Port of Livorno provides optimization of the intra-terminal operations.

Impacted Areas & Business Value

- Added Value:
  - Lower time to find & handle cargo
  - Reduced accidents
  - Less operational inefficiencies & fewer human mistakes
  - Reduced economic costs & improved competitiveness

#Operations **#ProcessControl** **#Sustainability**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

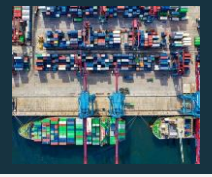
Use Case Type

- **B2B**
- **B2C**

#AI **#IoT** **#Edge** **#AR/VR**

Ericsson

Automated Factory Parking (AFP) solution



Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- Ericsson and Unikie are collaborating for an automated factory parking solution with Ericsson's 5G SA private network. Finnish company Unikie developed software for real-time autonomous operation and process management in automotive and industrial solutions, including automated factory parking and valet parking. Vehicle logistic management at the factory have been fully automated due to reliable connectivity, low latency to meet safety requirements, and the high-security standards of the 5G private network.

Business Model & Key Actors

- Unikie provides the software for vehicle logistic management, and the solution relies on Ericsson's 5G standalone (SA) private networks.
- Key actors
  - Network equipment provider: Ericsson, Unikie
  - System integrator: Ericsson
  - Operator: /

Technical Architecture

- Vehicles are remotely controlled through a secure and reliable Ericsson 5G private network, utilizing edge computing and Unikie's Automated Factory Parking (AFP) solution. As cars roll off the production line, drivers move cars to a parking area before being shipped, which takes approximately 30 minutes. With Unikie's AFP solution of sensors and software, automakers can control and monitor the car factory route and automate parking.

Impacted Areas & Business Value

- Added Value:
  - Reduction in search time and labor costs
  - Parking space optimization up to 20%
  - Increased safety for onsite staff & minimum vehicle accidents

#Operations **#Safety**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

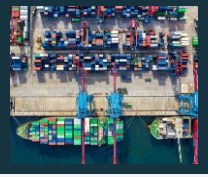
Use Case Type

- **B2B**
- **B2C**

#AI **#IoT** **#Edge**

Fermax & Faurecia

5G Fleet Management - Remotely Connected and Controllable Autonomous Robots



Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- 5G technology in the industrial field enables the development of remotely controlled transport robots to automate last-mile logistics, thus reducing processes and costs. For indoor context, the RB-VOGUI robots perform a task of supplying production points from the warehouse (indoor transport), while for outdoor environment, the robot perform a task of transporting airbag racks.

Business Model & Key Actors

- Orange, Huawei, Robotnik, Intel and the Institute of Telecommunications and Multimedia Applications are developing a pilot whose tests will be conducted in indoor and outdoor environments.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: iTeam
  - Operator: Orange

Technical Architecture

- The pilot makes use of three RB-VOGUI robots (mod 3) that are connected to the 5G network and can be remotely controlled through it, testing this connection in both indoor and outdoor environments. In addition, these robots integrate Intel's cameras for improved odometric estimation and for location estimation using Visual SLAM. All this favors greater integration, robotization and optimization of the load distribution chain.

Impacted Areas & Business Value

- Added Value:
  - More efficient operations and supply chain
  - Reduced costs and risks

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

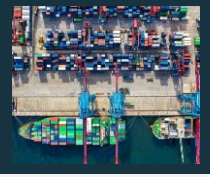
Use Case Type

- **B2B**
- **B2C**

#AI **#IoT** **#AGV** **#SLAM**

Beijing Daxing International Airport

Intelligent Travel System - Facial Recognition for Check-In & Security, combined with Paperless Luggage Service



Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- The Beijing Airport embraced 5G gigabit networks - both indoor and outdoor - to create a new, smart travel experience. China Eastern Airlines has innovatively combined facial recognition technology with 5G gigabit networks at Daxing International Airport. With 5G, facial recognition, and other supporting technologies like AR, VR, and AI, the airport has been able to provide upgraded services like "facial pass", baggage tracking, and recognition with AR glasses.

Business Model & Key Actors

- Huawei Technologies, China Eastern Airlines, and China Unicom have teamed up to jointly introduce a 5G-based smart travel system at the new Beijing Daxing International Airport.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: /
  - Operator: China Telecom

Technical Architecture

- Passengers traveling with China Eastern Airlines can use face scanning to check in their luggage, clear security, VIP room, and board the aircraft – all without the need to show an ID, hold tickets, or scan QR codes. To use the paperless luggage tracking service, passengers apply for reusable RFID luggage cards that they use with their smartphones to log flight numbers and destinations before physically dropping off their bags. Travelers can then track the status of their baggage using the airline's app.

Impacted Areas & Business Value

- Added Value:
  - Greater convenience for passengers through barrier-free experience (intervention-free and paperless)
  - Shorter inspection & boarding times

#Operations **#CustomerService** **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

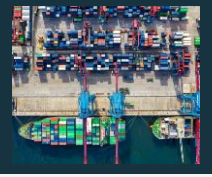
Use Case Type

- B2B
- B2C

#AI **#IoT** **#Analytics** **#RFID**

MIC

5G-Controled & Monitored Truck Platooning – Inter-Vehicle Communication & Remote Monitoring & Operation



Commercially Live
Pilot
Potential (Concept)
Start Year – 2017

Context

- In truck platooning, the trucks that make up the platoon share information with each other while traveling. There are two types of communication: vehicle-to-network-to-vehicle (V2N2V), where vehicles communicate with each other via a base station, and vehicle-to-vehicle (V2V), where vehicles directly communicate with each other. To achieve the required real-time communication between vehicles, low-latency communication is essential.

Business Model & Key Actors

- As part of the 5G Integrated Verification Trials in 2018 led by the MIC of Japan, SoftBank was contracted to conduct trials for truck platooning on a public highway and for utilizing the remote surveillance and the remote operation of the vehicles.
- Key actors
  - Network equipment provider: /
  - System integrator: Softbank
  - Operator: /

Technical Architecture

- A platoon is composed of a lead vehicle with a driver, while trailing vehicles are unmanned. The latency characteristics of 5G communication equipment were measured in tests, with consideration for use in vehicle control for platoon driving. The 4.7 GHz band was used in the tests, and the evaluation was done in a test environment with V2V communication via base station. The tests were done assuming truck speeds up to 90 km/h.

Impacted Areas & Business Value

- Added Value:
  - Less fuel consumption resulting in reduction in CO2 emissions between 15 - 25%
  - Mitigate traffic congestion (higher traffic capacity of roads because of shorter distance between trucks)
  - Reduce burden on drivers and increase safety

#Operations **#ProcessControl** **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness		●	
Sustainability	●		
Innovative Nature		●	
AI & Edge			●
Maturity	●		

Functional drivers of 5G that facilitate the initiative

Enhanced mobile broadband	Ultra-reliable low latency comms.	Massive machine-type comms.

#AI **#IoT** **#IoT** **#V2N**

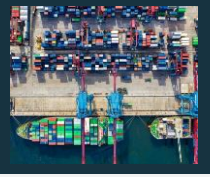
Use Case Type

B2B

B2C

Port of Bristol

5G Smart Freeport - Security, traceability, and tracking of goods within and across extendable virtual boundaries



Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- 5G products and services will be developed to support the smart and dynamic port and customs environment, delivering traceability and real-time tracking of goods, and their condition, within and across extendable virtual boundaries – and between public and private networks. It will demonstrate how 5G private network capabilities can offer efficiency and productivity improvements to the logistics sector and more widely.

Business Model & Key Actors

- The WECA is leading a consortium of partners on the 5G Logistics project. The program will help to support operations at Bristol Port and Gravity Smart Campus.
- Key actors
  - Network equipment provider: Cellnex
  - System integrator: /
  - Operator: /

Technical Architecture

- N/A

Impacted Areas & Business Value

- Added Value:
  - Upgraded operational efficiency
  - Greater security

#Operations **#ProcessControl**

	High	Medium	Low
Performance & Investment Gains			●
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

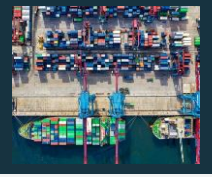
Use Case Type

- **B2B**
- **B2C**

#IoT **#Edge**

Port of Livorno

5G-Controlled Corridors for Cargo Tracking Truck Appointment



Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- The use case consists in a modular solution adaptable to each port's needs with a multi-phased implementation for a smooth assimilation by stakeholders and effective integration in daily activities. It provides a web-based platform accessible from any device with Internet connection, without specific software or additional hardware needed. A complementary mobile application is also available and allows multi-sided communication with drivers and geolocation tracking.

Business Model & Key Actors

- As part of the EU Horizon 2020, TIM, Authority Port of Livorno, CNIT, and FEEM, Ericsson is enabling sustainable growth in ports with 5G, the port is currently subject to a research innovation action project named COREALIS.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: TIM

Technical Architecture

- The trial involves a 5G-based control module for managing general cargo. It performs real-time control of loading/unloading operations, collecting data via yard vehicles and implanted sensors (e.g., LIDAR, WDR cameras and tablets), and making operating decisions based on real-time analytical processing. The instantiation of a pervasive 5G network in a container terminal at the Port of Livorno provides optimization of the intra-terminal operations.

Impacted Areas & Business Value

- Added Value:
  - Reduced traffic congestion
  - Decrease in pollution
  - Increased visibility of load and road safety
  - Positive consequences for updating education programs, and on-the-job and continuous training

#Operations **#ProcessControl** **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

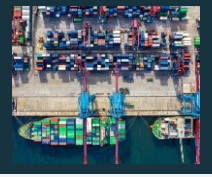
Use Case Type

- B2B
- B2C

#AI **#Edge** **#IoT** **#AR/VR**

DB Schenker - Einride

5G Self-Driving Trucks - Autonomous Electric Trucks



Commercially Live
Pilot
Potential (Concept)
Start Year – 2018

Context

- Transportation powered by fossil fuels is a major contributor to global emissions, as well as a safety hazard on the road. Ericsson teamed up with DB Schenker to co-create a safer and more sustainable transport ecosystem using 5G to connect all-electric, automated vehicles. Switching to electric vehicles can reduce the CO2 emissions of a logistics network by 90 percent, and commercial vehicles being driverless means less downtime, more reliability and more overall cost-effectiveness and healthier air quality and sustainable cities.

Business Model & Key Actors

- Einride, Ericsson and Telia are putting 5G into motion at a DB Schenker facility in Jönköping, Sweden.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: /
  - Operator: Telia

Technical Architecture

- The goal of the project was to power an all-electric, autonomous transport ecosystem that takes fleet management to the next level. To this end, Ericsson's Cloud Core for 5G powered the first commercial installation of Einride's Autonomous Electric Transportation (AET) system.

Impacted Areas & Business Value

- Added Value:
  - Cost-effective solution
  - Positive sustainable impact (up to 90% reduction in CO2 emissions)
  - Replacement rate of current transportation methods up to 60%

#Operations **#Sustainability**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

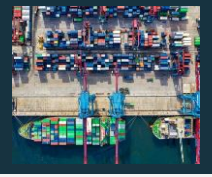
Use Case Type

- **B2B**
- **B2C**

#IoT **#AI**

KT Corp

5G Self-Driving Freight Carts - Automated Logistics Vehicles



Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- South Korea's largest telecommunications company, announced that it is using 5G self-driving carts at its logistics center. KT incorporated its autonomous intelligent vehicle (AIV) service to NarGo and Targo. AIV service is an integrated control system that processes instructions and assesses operating conditions by using pre-installed maps and real-time information on automated carts. It also facilitates latency-free collection and analysis of operational data as well as statistics compilation.

Business Model & Key Actors

- KT uses 5G self-driving carts at its logistics center. Two types of 5G self-driving carts, "NarGo" and "TarGo," are being employed in collaboration with Twinny, a company specializing in indoor autonomous robots and online platforms.
- Key actors
  - Network equipment provider: /
  - System integrator: KT Corp
  - Operator: KT Corp

Technical Architecture

- The self-driving logistics vehicles and AIV service are based on KT's integrated mobility platform, dubbed "5G Mobility Makers." The platform is at the core of KT's connected car services, which feature automated driving control by collecting and analyzing data produced by different vehicles. Utilizing this capability led to real-time remote control of AIV cloud control centers developed by partner companies and various business sites.

Impacted Areas & Business Value

- Added Value:
  - Improved productivity - 50% reduction in employees' travel range for loading and transporting inventory

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

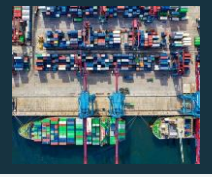
Use Case Type

- B2B
- B2C

#IoT **#AI**

Port of Felixstowe

5G for Marine Industry – Remote Controlled Cranes & Sensors for Predictive Maintenance



Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- The project test the potential of 5G across two use cases: enabling remote-controlled cranes via the transmission of CCTV and deploying IoT sensors and AI to optimize the predictive maintenance cycle of Felixstowe's 31 quay-side and 82 yard cranes. Harnessing the speed, low-latency and high-capacity of 5G, the project demonstrate the productivity and efficiency gains of such technology, whilst reducing unplanned outage.

Business Model & Key Actors

- The solution relies on partnerships with Three UK (using its 5G private network), Cambridge University and Blue Mesh Solutions, along with key subcontractors Ericsson and Siemens.
- Key actors
  - Network equipment provider: Ericsson, Siemens
  - System integrator: Ericsson, Siemens
  - Operator: Three UK

Technical Architecture

- N/A

Impacted Areas & Business Value

- Added Value:
  - Enhanced productivity
  - Improved efficiency
  - Reinforced safety

#Operations **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

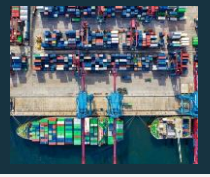
Use Case Type

- **B2B**
- **B2C**

#AI **#ML** **#CCTV** **#IoT**

Port of Livorno

5G for Safe & Sustainable Ship Practices – Distributed Sensor System & MIoT Cameras



Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- For prediction of pollution levels for future, the regular monitoring and assessment are required during the entire construction and operation phase of a major port. The power of 5G and the underlying connectivity allows the port of Livorno to leverage a network of sensors and cameras to determine the levels of pollution, identify the respective (pollution) sources, control and dispose of waste from various point and non-point sources.

Business Model & Key Actors

- Using a 5G Private Network installed by Three UK. As part of the EU Horizon 2020, TIM, Authority Port of Livorno, CNIT, and FEEM, Ericsson is enabling sustainable growth in ports with 5G, the port is currently subject to a research innovation action project named COREALIS.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: TIM

Technical Architecture

- The trial involves a 5G-based control module for managing general cargo. It performs real-time control of loading/unloading operations, collecting data via yard vehicles and implanted sensors (e.g., LIDAR, WDR cameras and tablets), and making operating decisions based on real-time analytical processing. The instantiation of a pervasive 5G network in a container terminal at the Port of Livorno provides optimization of the intra-terminal operations.

Impacted Areas & Business Value

- Added Value:
  - Major safety improvements through 5G-enabled MIoT sensors
  - Reduced number of accidents
  - Positive environmental impact via pollution management

#Operations **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

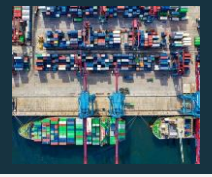
B2B

B2C

#AI **#Edge** **#AR/VR** **#IoT**

Administration of the Port of Aveiro (APA)

Railway Safety System Solution - Level Crossing Control System



Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- A level crossing control system with 5G technology was launched in the rail access to the main Multipurpose Terminal of the Port of Aveiro. The transportation pilot, led by EFACEC, proposes to use the 5G slice capabilities in order to replace the wired communication used nowadays on railway level crossing environments. This should reinforce the safety conditions by transmitting video images to train drivers and maintenance agents.

Business Model & Key Actors

- The project was developed by EFACEC in partnership with the Administration of the Port of Aveiro (APA). It is supported by the European program " Horizon 2020 ".
- Key actors
  - Network equipment provider: /
  - System integrator: EFACEC
  - Operator: /

Technical Architecture

- 5G technology offers more speed and security to satisfy the communication requirements, allowing communications between the sensors for detecting the approaching trainsets and the level crossing controllers, typically supported on copper cables, are carried out by radio communications (wireless) with 5G technology. Additionally, the solution enables real-time, high-definition video transmission between cameras located in the area of the level crossing and inside the train.

Impacted Areas & Business Value

- Added Value:
  - Reinforced safety conditions
  - Reduced number of train accidents
  - Indirect cost reduction associated with damages (materials & human lives)

#Operations **#UrbanMobility** **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#Edge** **#IoT**

ENERGY & UTILITIES

Belgium is undertaking strong initiatives through its national energy and climate plan in which it targets a reduction of greenhouse gas emissions from the energy sector by 35% compared to 2005, a threshold of renewables in the gross final energy consumption set at 17.5% and a substantial cut in the energy demand - all by 2030.

NATIONAL ACCOUNTS

Value Added *(Euro, Millions)*
10,574

Labour input *(Persons, thousand)*
53

Gross Fixed Capital Formation *(Euro, Millions)*
5998

Gross Fixed Assets *(Euro, Millions)*
95,308

CHALLENGES

Increasingly complex operations

Renewable energy sources tied to the grid have expanded, resulting in additional generation points and putting grid reliability and cybersecurity at risk

Reinforcement of service delivery resiliency

Extreme weather and climate events have jeopardized reliability in terms of energy supply.

Digital transition

Technology and the cloud offered opportunities to be seize to harness the full potential of the burgeoning wave of connected devices and data.

Key role in sustainability concerns

More and more companies in the sector are expected to announce their intermediate and final goals, refine their strategic sustainability plans, and become more consistent on ESG issues.

Changing preferences

Remote working, sustainable awareness, and similar factors are leading to variable consumption patterns and new expectations from consumers.

TRENDS

15% Decreased of the overall energy production in 2020, while total CO2 emissions have dropped by 21% since 1990.

x 2+ Belgium has more than doubled its share of renewables in electricity generation and reached almost 20% in 2018.

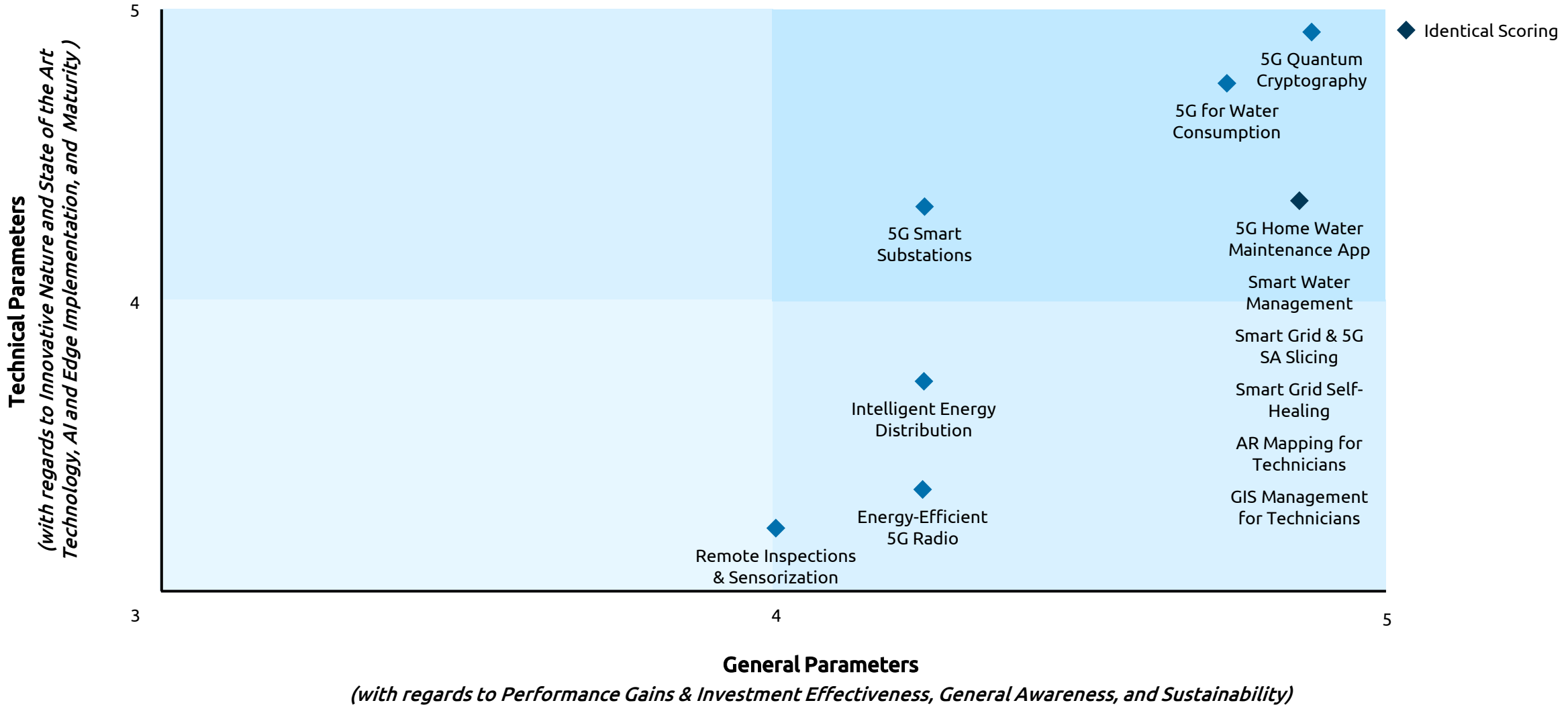
ENERGY & UTILITIES ECOSYSTEM

Generation	Transmission	Distribution	Supply

5G use cases in each area of the ecosystem

Generation	Transmission	Distribution	Supply
5G Smart Substations	5G Remote Inspection & Sensorization in Substations	Intelligent Energy Distribution with 5G	5G-Based Smart Water Management
5G Quantum Cryptography	Energy-Efficient 5G Radio	Smart Grid Powered by 5G SA-Based Network Slicing	5G for Water Consumption
		5G Smart Grid Self-Healing	5G-Powered AR Mapping for Technicians
		5G-Supported GIS Management for Technicians	5G-Home Water Maintenance App

ENERGY & UTILITIES USE CASES MAPPING



UK Power Networks

5G Smart Substations - Intelligent Grid Devices And For Secure, Resilient, And Fast Data Telemetry

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- Vodafone and UK Power Networks, the country's biggest electricity network operator, announced a trial to connect parts of the UK's electricity network with 5G. The deal is part of the Constellation project, which will see powerful computers installed in electricity substations so they can communicate with each other in real time, over 5G, to improve efficiency. Increasing efficiency will enable more clean energy sources and low carbon technologies like electric vehicles to connect to the network.

Business Model & Key Actors

- Vodafone has partnered with UKPN to help deliver Constellation, the electricity network operator's revolutionary smart substation trial.
- Key actors
  - Network equipment provider: GE Digital
  - System integrator: GE Digital
  - Operator: Vodafone

Technical Architecture

- Vodafone provides 5G connectivity to electricity substations, making them more efficient and freeing up capacity for clean energy to help reach the UK's target of net zero carbon emissions by 2050. Using 5G, grid devices exchange data 100 times faster than they would using 3G and ten times faster than 4G.

Impacted Areas & Business Value

- Added Value:
  - More efficient & greener electricity network
  - 63,700 tons of CO2 saved by 2050 (if rolled out across the UK)

#Operations **#ProcessControl**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#ML **#Software**

Korea Hydro & Nuclear Power Co., Ltd.(KHNP)

5G Quantum Cryptography – Power Plant Management

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- Korea Hydro & Nuclear Power Co., Ltd.(KHNP) decided to apply Quantum Key Distribution (QKD) to the communication network connecting its Hydro & Nuclear Power headquarters and its Power plant to improve the security of their network at the plant, blocking the source of hacking concerns. SK Telecom and KHNP have been working together to make various pilot projects, streamline the power generation process, and enhance security.

Business Model & Key Actors

- ID Quantique (IDQ), the world leader in Quantum Safe security solutions, SK Telecom and KHNP collaborated for the Quantum Secured Smart Plant in Korea providing ultra-high security for its network.
- Key actors
  - Network equipment provider: ID Quantique
  - System integrator: /
  - Operator: SK Telecom

Technical Architecture

- SK Telecom and KHNP built a private 5G base to prevent leakage of mobile business data in power generation facilities. They implemented a full-fledged smart plant to produce energy efficiently using 5G, quantum cryptography with ID Quantique's quantum-safe solutions, artificial intelligence and the cloud. Moreover, Quantum Key Distribution (QKD) and Quantum Random Number Generation (QRNG) will be applied for Dual Security for on-site mobile access.

Impacted Areas & Business Value

- Added Value:
  - Efficient energy production
  - Operational optimization via real-time monitoring of equipment condition

#Operations **#Sustainability**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

Enhanced mobile broadband	Ultra-reliable low latency comms.	Massive machine-type comms.

Use Case Type

B2B

B2C

#AI **#DigitalTwin** **#Quantum**

RED Electrica

5G Remote Inspection & Sensorization in Substations

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- 5G favors remote inspection of electrical installations by setting up monitoring systems that improve the efficiency of fault detection, which in turn increase safety. By using artificial vision from different spectra, and the detection of SO2/SF6 gas (indicator of substation failures and greenhouse gas leaks) both in electrical substations and in the pipelines that run through them, several Spanish partners are developing a solution for more efficient and safer controls.

Business Model & Key Actors

- Orange, Huawei and Elewit (as a technology platform of the Red Eléctrica Group) developed a pilot for remote inspection of facilities.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: Orange

Technical Architecture

- The tests are being carried out at the Morvedre substation, located near Sagunto, which is also of critical importance in the province's grid. A network of sensors and specific cameras is used, both at fixed and mobile points, with a monitoring system in different wavelengths that improves the efficiency of fault detection, increases the safety of field operators and allows the development of more powerful tools or predictive maintenance.

Impacted Areas & Business Value

- Added Value:
  - Greater safety & anticipation of possible infrastructure accidents
  - Faster response time
  - Greater monitoring and control of the installation

#ProcessControl **#Safety**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability			●
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#IoT** **#Edge** **#CCTV**

Vodafone Network Energy Performance

Energy-Efficient 5G Radio - Upgraded antenna-integrated radio (AIR)

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- Business success should not come at cost to the environment and action are needed to address the climate emergency. To improve network energy performance, Ericsson and Vodafone have completed the first deployment of a new energy-efficient 5G radio (AIR 3227). Designed for future-proof and sustainable networks, Ericsson's new radio is 51 percent lighter and more compact. Improved energy management features help to optimize overall site footprint, making 5G rollout and 4G upgrades faster and easier.

Business Model & Key Actors

- Vodafone has partnered with Ericsson to install new antenna-integrated radio (AIR) solutions on the roof of Speechmark, its Central London headquarters.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: Vodafone

Technical Architecture

- The AIR 3227 is a mid-band radio with 32 transmitters (32T) and 32 receivers (32R) supporting both LTE and New Radio (NR). Some of the characteristics of the AIR 3227 include lower inter-cell interference, leading to improved network performance, high order spatial multiplexing and multi-user MIMO (MU-MIMO) support, full radio resource utilization in vertical and horizontal beamforming.

Impacted Areas & Business Value

- Added Value:
  - Energy Efficiency
  - Daily energy consumption decrease by an average of 43%

#Sustainability

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge			●
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#LTE **#MIMO**

ESB Networks & CEZ Group + European Utility Companies (Global)

Intelligent Energy Distribution with 5G - Data-driven monitoring and control of power infrastructure

Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- Higher levels of consumption and new patterns of energy flow mean a greater need for visibility and identification of bottlenecks to maximize service performance. Service Oriented Grid for the Network of the Future (SOGNO) has been established to address the growing need for distribution system operators (DSOs) to have real-time insights into network operation, as well as to remotely optimize their processes for a cost-efficient, seamless and secure power supply for customers.

Business Model & Key Actors

- Ericsson united 13 prominent partners, including utility companies, for the EU's SOGNO initiative to explore how modernization and digitalization can help to create the power networks of the future.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: ESB Networks (Ir)

Technical Architecture

- Leading utility companies in Ireland and Romania wanted to minimize customer outages due to events damaging overhead power lines (causing financial penalties), to increase network monitoring and visibility, and to explore more renewables energy sources to include. To achieve this, the solution harnesses 5G to help virtualize automation services and locate them in the 5G Edge infrastructure. Combined with innovative sensors, data analysis techniques and 5G-based ICT, it provides support to DSOs with real-time control and decision-making in planning.

Impacted Areas & Business Value

- Added Value:
  - Improved operational efficiency, reliability and planning of power networks
  - More efficient renewable energy source integration
  - Faster recovery from system outages

#ProcessControl **#Operations**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#Cloud **#IoT** **#Edge**

SGCC (State Grid Corporation of China)

Smart Grid Powered by 5G - SA-based Network Slicing

Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- Huawei teamed up with China Telecom Nanjing and State Grid Corporation of China (SGCC) Nanjing to use electric terminals for end-to-end field tests on the 5G SA electricity slice. After deploying 5G base stations in the Drum-Tower Square and Lishui District, China Telecom Nanjing performed indoor and outdoor local-end, mid-end, remote-end, and obstacle blocking tests. The slice proved to meet mission-critical requirements for millisecond-level precise management of load processing units running on telecom networks.

Business Model & Key Actors

- China Telecom Jiangsu, State Grid Corporation of China (SGCC) Nanjing Power Supply Company, and Huawei completed the world's first electricity slice to comply with the latest 5G SA specifications released by 3GPP.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: China Telecom

Technical Architecture

- The SA electricity slice fully utilizes the millisecond-level latency advantage on 5G networks and SLA assurance of network slicing. It enhances bidirectional communication between power grids and end users, and ensures precise management of small power units on power grid terminals of overloaded power grids. These advantages help minimize the economic and social impact caused by power outages.

Impacted Areas & Business Value

- Added Value:
  - Massive & super-fast connectivity meeting the industrial requirements via numerous terminals
  - Cost-effective solution maintaining high-standard of security and isolation
  - Ultra-robust reliability at 99.999%

#ProcessControl **#Operations** **#Sustainability**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- B2B
- B2C

#AI **#IoT** **#Edge**

EFACEC

5G Smart Grid Self-Healing - High Speed P2P Communication Algorithm

Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- As part of the SliceNet project, EFACEC have devised a Smart Grid Self-Healing solution. With access to modern wireless technologies like 5G, the algorithm resorts to high-speed peer-to-peer communication to provide a fast and reliable self-healing solution. Thanks to the solution, outage time is reduced for a large number of customers because the algorithm promptly re-configures the grid automatically, powering the healthy line section from an alternative medium voltage feeder.

Business Model & Key Actors

- This SliceNet use case focuses on Smart Grid Self-Healing, proposed by EFACEC (EFA), a company of the EFACEC Power Solutions Group, the largest Portuguese group in the electromechanical area.
- Key actors
  - Network equipment provider: /
  - System integrator: Altice Labs & EFA
  - Operator: /

Technical Architecture

- The Digital Service Provider (DSP) provide the customer with an E2E slice with specific vertical requirements (e.g., URLLC). This E2E slice is composed of 2 network slices given by Network Service Provider A (NSaaS A) and Network Service Provider B (NSaaS B), enabling the exploration of a multi-domain slicing scenario. The energy power grid Intelligent Electronic Devices (IEDs) connect the RANs provided by the Network Service Providers.

Impacted Areas & Business Value

- Added Value:
  - Significant reduction in the outage duration, number of affected customers as well as in the number of switching manoeuvres required during network reconfiguration procedure involved in Fault Detection Isolation and service Restoration (FDIR)

#Sustainability **#Operations**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

#Edge **#IoT**

Use Case Type

- **B2B**
- **B2C**

Northumbrian Water

5G-Supported GIS Management for Technicians - Quick Access & Upload of Crucial Data

Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- Uninterrupted network access and 5G connectivity aims to improve water and sewerage services for almost 2.7 million customers. Northumbrian Water requires a range of technical skills and competencies in order to manage the logistical challenge of maintaining water and sewerage services across the North East region. GIS management allows field technicians and engineers to quickly access and upload crucial data from NWG's central GIS database, without requiring a Wi-Fi or cable connection.

Business Model & Key Actors

- Ericsson, UK Communications Service Provider O2 and English utility Northumbrian Water are partnering on 5G trials to increase productivity, efficiency and safety in the sector.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: O2

Technical Architecture

- The rollout of O2's 5G network is providing faster speeds, lower latency and greater network coverage. Ericsson installed the Private Network solution for Northumbrian Water, including the Ericsson Radio Dot System, to deliver unparalleled indoor 5G coverage and capacity for the trials at the Washington Water Treatment Plant in Tyne and Wear.

Impacted Areas & Business Value

- Added Value:
  - Improved water and sewerage services by increasing productivity, efficiency, and safety through uninterrupted network

#ProcessControl **#Operations** **#Saftey**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#GIS **#Cloud**

Xiajiang Village

5G-Based Smart Water Management

Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- Traditional means of water quality monitoring and control lacked automation, and were characterized by few monitoring points, and slow sampling rates. In view of these problems, ZTE has upgraded the capability of IoT platform to incubate and deploy solutions combining BD and AI technologies. Meanwhile, China Telecom and ZTE have created the E2E 5G-based Smart Water-control and Monitoring providing an intelligent management and three-dimensional monitoring.

Business Model & Key Actors

- ZTE and Zhejiang Branch of China Telecom have launched a 5G site to implement 5G intelligent water management solution in Xiajiang Village, which is near Qiandao Lake.
- Key actors
  - Network equipment provider: ZTE
  - System integrator: ZTE
  - Operator: China Telecom

Technical Architecture

- Based on China Telecom's 5G network, ZTE's solution realizes mainly UAV inspection, HD real-time video monitoring, and VR remote control. The purpose is to identify foreign objects (e.g., solid waste) on the water surface. If those objects are deemed undesirable, they are removed. Multi-dimensional data from connected water quality sensors is aggregated on the ZTE IoT platform, and intelligent processing allows pollution prediction. This provides a scientific basis for preventive and proactive water management.

Impacted Areas & Business Value

- Added Value:
  - Greater accuracy through more data
  - Better recognition accuracy via more qualitative videos (HD)
  - Better detection cost thanks to a wider coverage

#ProcessControl **#Operations** **#Sustainability**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#AR** **#BigData** **#Edge** **#IoT** **#UAV**

Idrica

5G for Water Consumption - Smart Water Meter

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- Spanish water industry service provider Idrica is piloting the first 5G device for remote reading of water. The solution focuses on remote reading of drinking water consumption in real time, and the sending of information via the 5G network to a management center for analysis, pricing and processing. Features include improved energy efficiency, guarantee of service in adverse conditions and reduced latency to milliseconds, while other benefits of 5G technologies include network slicing for multi-service provision and edge computing.

Business Model & Key Actors

- The pilot project is being conducted in conjunction with Orange, Huawei and other water industry partners such as Arborea Intellbird, CFZ Cobots, Etra Investigación y Desarrollo, Visyon (Estudio Bay), Elewit and Robotnik.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: iTEAM
  - Operator: Orange

Technical Architecture

- The project involves the remote reading of 30 drinking water meters in different locations on the Universidad Politécnica de Valencia's (UPV) campus. The 5G network is used to send information to Idrica's integrated management platform, a solution based on advanced analytics and algorithms. The data obtained is used to draw conclusions about the capacity of 5G to connect millions of devices in the future, as well as its potential for the early detection of risks and emergencies, thanks to real-time meter reading.

Impacted Areas & Business Value

- Added Value:
  - More efficient and faster decision process
  - Early detection of risks and emergencies

#Operations

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#IoT** **#Edge** **#Analytics**

Northumbrian Water

5G-Powered AR Mapping for Technicians

Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- 5G-enabled augmented reality (AR) technology allow experienced technicians to remotely guide on-the-ground teams through complex tasks by relaying real-time data and instructions, creating 'Remote Experts'. The technology allows multiple experts to join one call simultaneously, adding valuable second opinions. The technology could be extended to cover the layout of water mains, pipes and conduits and would help engineers manage risks and hazards in real-time.

Business Model & Key Actors

- Ericsson, UK Communications Service Provider O2 and English utility Northumbrian Water are partnering on 5G trials to increase productivity, efficiency and safety in the sector.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: O2

Technical Architecture

- The rollout of O2's 5G network is providing faster speeds, lower latency and greater network coverage. Ericsson will install the Private Network solution for Northumbrian Water, including the Ericsson Radio Dot System, to deliver unparalleled indoor 5G coverage and capacity for the trials at the Washington Water Treatment Plant in Tyne and Wear.

Impacted Areas & Business Value

- Added Value:
  - Improved water and sewerage services by increasing productivity, efficiency, and safety through uninterrupted network

#Processcontrol **#Operations** **#Saftey**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

B2B

B2C

#AR **#RealTimeVideo**

Northumbrian Water

5G-Home Water Maintenance App

Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- The trial demonstrates how 5G can transform operations in the utilities sector, such as water supply and sewerage services, which will positively impact millions of people in the local area. Part of the solution involves an application for consumers to monitor their home's water supply and flow, identifying any unusual patterns to flag potential issues ahead of time.

Business Model & Key Actors

- Ericsson, UK Communications Service Provider O2 and English utility Northumbrian Water are partnering on 5G trials to increase productivity, efficiency and safety in the sector..
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: O2

Technical Architecture

- Real-time home's water supply and flow monitoring. The rollout of O2's 5G network is providing faster speeds, lower latency and greater network coverage. Ericsson will install the Private Network solution for Northumbrian Water, including the Ericsson Radio Dot System, to deliver unparalleled indoor 5G coverage and capacity for the trials at the Washington Water Treatment Plant in Tyne and Wear.

Impacted Areas & Business Value

- Added Value:
  - Improved water and sewerage services by increasing productivity, efficiency, and safety through uninterrupted network

#Customerservice **#Saftey**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- B2B
- B2C

#AI **#ML**

PUBLIC SAFETY & DEFENSE

Belgium is seeking to boost its spending in the defense sector, given its position as an active member of joint operations with the EU and peacekeeping efforts with NATO and the United Nations (UN).

NATIONAL ACCOUNTS

Value Added *(Euro, Millions)*
16,378

Labour input *(Persons, thousand)*
221

Gross Fixed Capital Formation *(Euro, Millions)*
2384

Gross Fixed Assets *(Euro, Millions)*
50,782

CHALLENGES

Digital awareness to optimize & minimize response time while maintaining security and resiliency

The operationalization includes new factors such as remote work or the involvement of citizens & third parties, which means a substantial rise in the number of communications.

Complexifying landscape - reemergence of great power competition - and greater threats

The VUCA world (volatile, uncertain, complex and ambiguous) calls for increasing resources, which can be leveraged through cooperation, shared awareness and scalable tools.

Environmental hazard

The necessity to decrease footprint, notably in terms of logistics by, for example, investing in greener technology.

TRENDS

€14bn The incremental amount announced by the Belgian government to be injected into defense, spread over the next 8 years.

1/4 Of defense spending is allocated to the major equipment category and their relative R&D expenditures.

€500M As new investments in police and justice declared by the new Belgian government when it took office in 2020.

PUBLIC SAFETY & DEFENSE ECOSYSTEM

Crisis & Safety Management

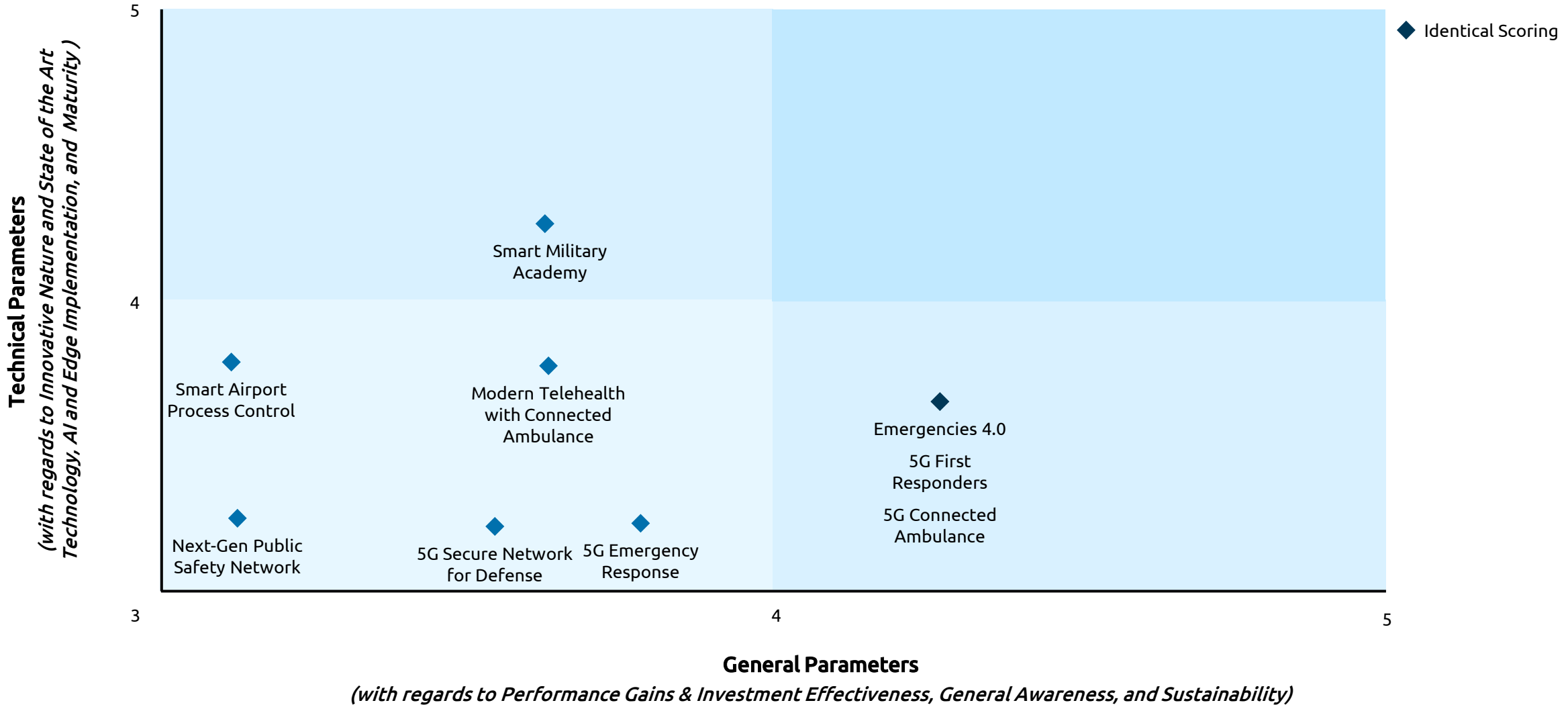
National Security & Border Management

Justice & Law Enforcement

5G use cases in each area of the ecosystem

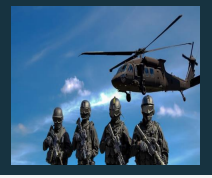
- Emergencies 4.0 with 5G
- 5G First Responders
- Modern Telehealth with Connected Ambulance
- 5G Emergency Response
- 5G Connected Ambulance
- 5G Smart Military Academy
- Smart Airport Process Control with 5G
- 5G Secure Network for Defense
- Next-Gen Public Safety Network

PUBLIC SAFETY & DEFENSE USE CASES MAPPING



Generalitat Valenciana

Emergencies 4.0 with 5G - Drones for Emergency Situation



Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- In emergency situations, the time required before the arrival of the first responders are sometimes precious minutes lost. The use of 5G ensures connectivity in emergency situations, allowing the area to be inspected remotely and analysed in real time. The project enables emergency management based on the navigation of remotely piloted drones from an integrated emergency management platform.

Business Model & Key Actors

- Orange, Huawei and ETRA deploy a mobile unit in the Port of Sagunto for the Generalitat Valenciana.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: Orange

Technical Architecture

- The images recorded by the on-board camera on the drone itself are transferred in real time to a 360° immersive visualisation model which, by means of augmented reality glasses. These images allow the user to access in real time the 3D images captured by the camera together with the information on the incident collected on the platform through an augmented reality model.

Impacted Areas & Business Value

- Added Value:
  - Immediate remote monitoring of the emergency area
  - Ability to coordinate actions
  - Robust & real-time communications

#Operations **#Process Control**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- **Ultra-reliable low latency comms.**
- Massive machine-type comms.

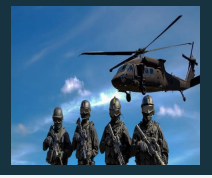
#AI **#IoT** **#Edge**

Use Case Type

- **B2B**
- **B2C**

Sabadell City

5G First Responders - RealWear HMT device (voice operated) for high-quality video sharing



Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- When there is an emergency in the street, the first person to arrive is often a local policeman agent. The project is intended to cover these first moments when care is crucial, and the ambulance is still to arrive. The objective is to stabilise the patient by giving first aid through high-quality video communications with a doctor until the arrival of the ambulance, which will then be prepared on the basis of initial diagnosis. The emergency service can likewise be suitably prepared to receive the patient and to give proper care.

Business Model & Key Actors

- The network is provided by Orange, while relying on Ericsson's 5G technology. Cisco is the device provider.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: Orange

Technical Architecture

- The pilot relies on the Orange network with Ericsson's 5G technology, with commercial 5G radio and core equipment on NSA technology in the 3.5Hz band. The connection between the policeman and the pediatrician is made with the RealWear HMT device (which fits on the head and allows for sharing of high-quality video. It is, moreover, voice-operated, which leaves the police agent hands free to help the patient. The doctor can meanwhile view the video images from the goggles and share graphic information.

Impacted Areas & Business Value

- Added Value:
  - Operational Efficiency
  - Reduced response time - Better patient management

#Operations **#CustomerService**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- **Ultra-reliable low latency comms.**
- Massive machine-type comms.

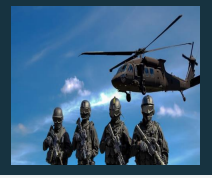
Use Case Type

- **B2B**
- **B2C**

#AR **#HMT**

Fibocom

Modern Telehealth - Connected Ambulance through IoT Modules



Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- With the development of the Internet of Things technology, many high-tech technologies are gradually introduced into the medical emergency system. 5G IoT modules enables real-time information sharing between the ambulance and central hospital, allowing experts to provide guidance to paramedics via means of connected medical equipment and HD video conference, greatly improving the quality of emergency service and increase the possibility of successful rescues.

Business Model & Key Actors

- Fibocom 5G/ LTE-A/ LTE-A Pro/ LTE Wireless Modules Enable High-Speed Internet of Things Scenarios, Bringing Perfect Wireless Experience to End Users.
- Key actors
  - Network equipment provider: Fibocom
  - System integrator: Fibocom
  - Operator: /

Technical Architecture

- Fibocom's 5G modules support reliable and seamless data, audio and video transmission on medical equipment, cameras, VR/AR headsets, and 5G CPE, making these IoT operations feasible. With super-high transmission rate and ultra-low latency, 5G-enabled equipment reduce the chances of misdiagnosis by synchronizing accurate real-time information to the hospital. It also moves partial rescue measures forward by allowing emergency experts to instruct treatment from miles away.

Impacted Areas & Business Value

- Added Value:
  - Effective emergency operations thanks to more effective communications
  - Shorten rescue time through the end of delayed treatment (before the patient reaches the hospital)

#Operations **#CustomerService**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness		●	
Sustainability		●	
Innovative Nature	●		
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

Enhanced mobile broadband	Ultra-reliable low latency comms.	Massive machine-type comms.

Use Case Type

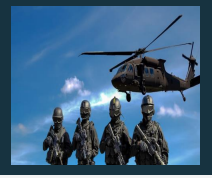
B2B

B2C

#VR **#IoT** **#AR** **#Analytics**

Altice Labs Campus

5G Emergency Response - Enhanced Emergency Response Abilities



Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- The ability of 5G to optimize and coordinate emergency service responses in the critical minutes following accidents has been highlighted in a demo led by Ericsson. Professionals from multiple Portuguese response agencies - police, ambulance service, fire brigade, and the civil protection authority - were equipped with body kit comprising cameras and sensors. These were connected via a 5G test network to a command center as they responded to a staged traffic accident, where the driver was trapped inside. There were also connected drones capturing overhead views.

Business Model & Key Actors

- The emergency response trial was conducted at the Altice Labs campus in Aveiro in partnership with local first responders. Ericsson configured a non-SA E2E 5G network for the demo.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: Altice

Technical Architecture

- The almost latency-free high-quality video stream and sensor provided instant feedback, including the real-time relative positions of all emergency personnel, allowing command center coordinators to act instantly to optimize operations. Real time monitoring of on-site environmental conditions - such as air quality, gasses and fumes - also improved the operational efficiency of on-site responses and actions. The first responders' own vital signs were also constantly monitored with all data coordinated in the command center.

Impacted Areas & Business Value

- Added Value:
  - Operational Efficiency
  - Effectiveness of First Time Responders

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

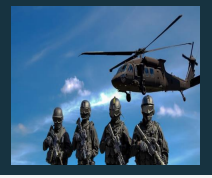
B2B

B2C

#VR **#IoT** **#UAV** **#Edge**

UHB & King's College London

5G Connected Ambulance - At-scene and In-Transit Care Solution



Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- With unprecedented new demands on the NHS and emergency services due to the coronavirus pandemic, the need for innovative ways of delivering healthcare is now more critical than ever. The 5G connected ambulance provides an innovative new way to connect patients, ambulance workers and remote medical experts in real time, enabling clinicians and paramedics to collaborate haptically, even when they are miles apart.

Business Model & Key Actors

- A collaboration between Ericsson, UHB and King's College London, healthcare workers have performed the UK's first remote diagnostic procedure over 5G network managed by BT.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: BT & Ericsson
  - Operator: BT

Technical Architecture

- A camera based in the ambulance transmits high-definition footage to the remote clinician. Using a VR headset and a joystick, the clinician can remotely guide the paramedic through a series of procedures based on haptic glove technology. The diagnosis is made possible by 5G's ultra-fast speeds and ultra-low latency. This makes it possible for there to be a mere millisecond delay between what is happening in the ambulance and what the clinician can see miles away.

Impacted Areas & Business Value

- Added Value:
  - Better care
  - Improve care efficiency

#Operations **#CustomerService**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

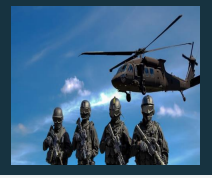
B2B

B2C

#AI **#Robotics** **#Haptics** **#VR** **#AR**

Korea Military Academy

5G Smart Military Academy - Smart Training Programs



Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- SK Telecom and the Korea Military Academy (KMA) develop 5G-based training programs for soldiers, such as VR shooting simulations. 5G's low latency and fast speeds allow classes to host over 200 soldiers-to-be for these programs. Trainees also get wearable devices so that the academy can use big data and AI to consistently check their conditions.

Business Model & Key Actors

- SK Telecom and Korea Military Academy are collaborating to create a "smart" academy that combines 5G wireless networks with the latest technology.
- Key actors
  - Network equipment provider: /
  - System integrator: SK Telecom
  - Operator: SK Telecom

Technical Architecture

- The academy implemented a military training system using VR and AR technology. The system is composed of VR-based shooting and tactical training simulators, AR-based command and control simulators and training effect analysis systems. Cadets also wore devices and were offered their fitness data analyzed by AI and big data technology. This provided them with consistent and systematic fitness information.

Impacted Areas & Business Value

- Added Value:
  - Learning & training path effectiveness
  - Faster readiness of on-the-ground soldiers

#Operations #HR

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness		●	
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- **Ultra-reliable low latency comms.**
- Massive machine-type comms.

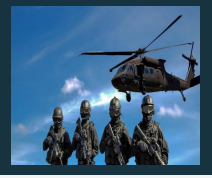
Use Case Type

- **B2B**
- **B2C**

#AI #AR #BigData #IOT #VR #Cloud

Hans Christian Andersen Airport

Smart Airport Process Control with 5G - Robot for Fence Inspection



Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- Airports, ports and many construction sites require several perimeter-fencing checks every day to comply with security and safety directives. Current methods usually involve employees patrolling the perimeter to check for signs of damage. At one time, when flying in and out of Hans Christian Andersen Airport and glancing out the window, it was possible to see a four-legged robot (Spot) freely patrolling the perimeter fence and checking for damage.

Business Model & Key Actors

- In collaboration with the Danish Technological Institute, the partners focused on how to unleash Spot – the robot developed by robotic company Boston Dynamics – on TDC NET's national commercial 5G network..
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Danish Technological Institute & Lorenz Technology
  - Operator: TDC Net

Technical Architecture

- The robot was connected to TDC NET's Ericsson-powered 5G. In theory where the 5G network goes, Spot can also go. In fact, the robot can navigate uneven terrain, climb stairs and get into small spaces. Equipped with 360-degree sensors, front and rear cameras and space for carrying packages and supplies, robots such as Spot could operate in the field as part of emergency response, rescue or industrial inspection missions.

Impacted Areas & Business Value

- Added Value:
  - Increased connectivity range & coverage for services
  - Greater safety & security as well as less human mistakes

#Processcontrol #Saftey

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness		●	
Sustainability		●	
Innovative Nature		●	
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- B2B
- B2C

#AI #ML #Robotics #IOT #Edge #DL

Estonian Ministry of Defense

5G Network for Cybersecurity Training

Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- With the evolution to Industry 4.0, industrial sectors are increasingly relying on digital systems to run their operations, exposing them to new cyber-attacks. To better protect networks and data, as well as national critical infrastructure, military agencies around the globe are investing in cybersecurity training. The Estonian training centers feature the latest technologies that are powering Industry 4.0 transformation, of which 5G networks and devices play a foundational role.

Business Model & Key Actors

- Nokia announced its private wireless Nokia Digital Automation Cloud (DAC) 5G standalone solution has been selected by the Estonian company Thinnect OÜ.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: /

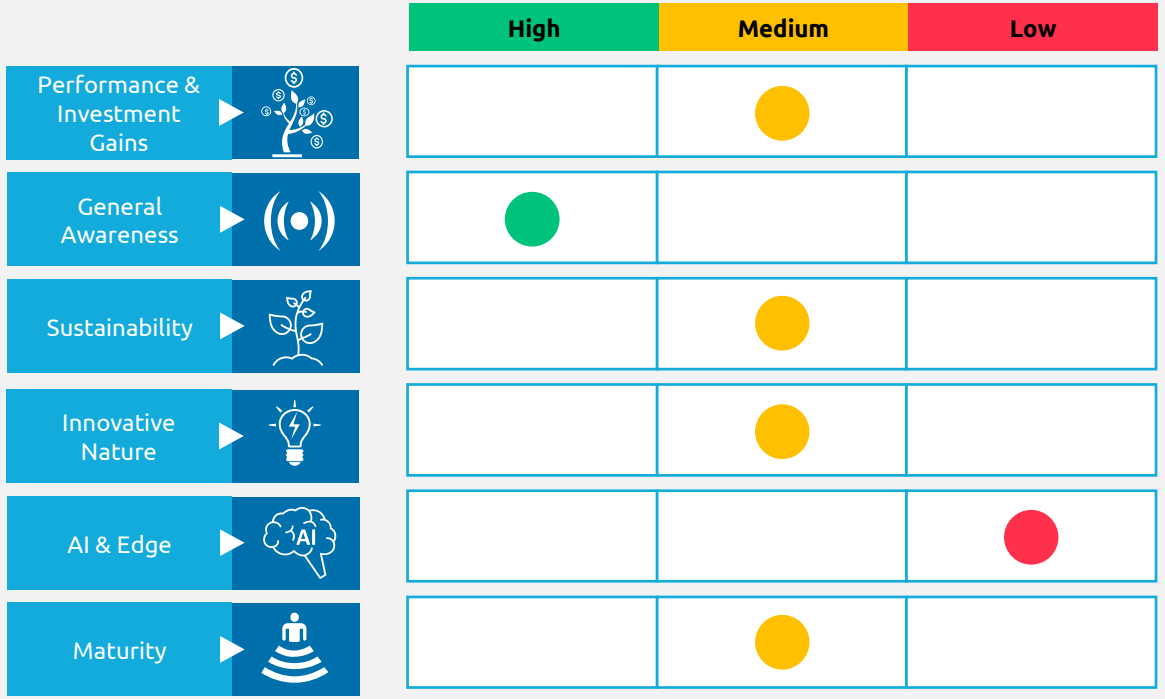
Technical Architecture

- Offered as a service, the Nokia DAC allowed Thinnect to implement a high-performance, end-to-end private wireless network using 5G to support ultra-low latency and real-time applications. The network support both physical and virtual simulations of cyber attacks and is used to develop tools to protect critical infrastructure systems.

Impacted Areas & Business Value

- Added Value:
  - Robust network and guarantee of data security
  - Better protection of national critical infrastructure systems

#Safety **#HR**



Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

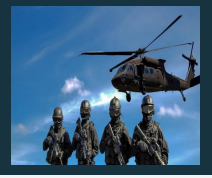
Use Case Type

- **B2B**
- **B2C**

#5GNetwork

Erillisverkot Group

Next-Gen Public Safety Network through Secure Network



Commercially Live
Pilot
Potential (Concept)

Start Year – 2021

Context

- In any emergency situation, instant, reliable and stable communication is key to enable and support successful operations. First time responders like fire-fighters, emergency medical service personnel or policemen need to be able to rely on fast and secure connectivity to save lives. To meet those demands, (Finnish) public safety agencies are increasingly turning to mobile 3GPP based solutions due to the capabilities provided by 4G and 5G - such as the secure and speedy sharing of data, images and video.

Business Model & Key Actors

- Ericsson has been selected by Erillisverkot Group for public authorities, emergency services and other critical services in Finland, to provide 5G next-generation core network products and solutions for its mission critical broadband network.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: /

Technical Architecture

- The next-generation Public Protection and Disaster Relief (PPDR) network initiative - called Virve 2.0 - is based on commercial mobile 3GPP technology with enhancements to meet security, availability and resilience. The ten-year deal taps Ericsson's dual-mode 5G Core portfolio on a common cloud-native platform. This delivers efficient total cost of ownership and enables the smooth introduction of 5G services. Ericsson NFVI, Service automation and VoLTE solutions are also included, alongside related deployment, learning and support services.

Impacted Areas & Business Value

- Added Value:
  - Smoothness in management and control of mission critical broadband network
  - Safeguard information security
  - Protect data integrity

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness		●	
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- **Ultra-reliable low latency comms.**
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#Edge** **#Analytics**

SMART CITIES

A genuine awareness is emerging about the Smart City in Belgium; it extends beyond the brand image. An inclusive dynamic is pacing the implementation with a human-centric approach.

NATIONAL ACCOUNTS

Value Added *(Euro, Millions)*
N/A

Labour input *(Persons, thousand)*
N/A

Gross Fixed Capital Formation *(Euro, Millions)*
N/A

Gross Fixed Assets *(Euro, Millions)*
N/A

CHALLENGES

Significant effect of quality of life

The mobility, the introduction of intelligent commuting methods and the increase of "green" spaces are must-haves.

Tightened sustainability laws

The increased requirements for a green society driving the necessity to promote a sustainable (and circular) economy with respect to the consumption of natural resources.

Technical constraints

The need for sound systems and networks in terms of infrastructure, cybersecurity and privacy.

TRENDS

3.7 is the average score that Belgian cities and municipalities assign to themselves out of 10. They regard themselves as not yet very advanced in terms of "Smart City" – the self scores amount to 3.5/10 (Flanders), 4/10 (Brussels), 3.7/10 (Wallonia).

35% of municipalities have already incorporated Smart City objectives into their strategy.

SMART CITIES ECOSYSTEM

Smart Infrastructure

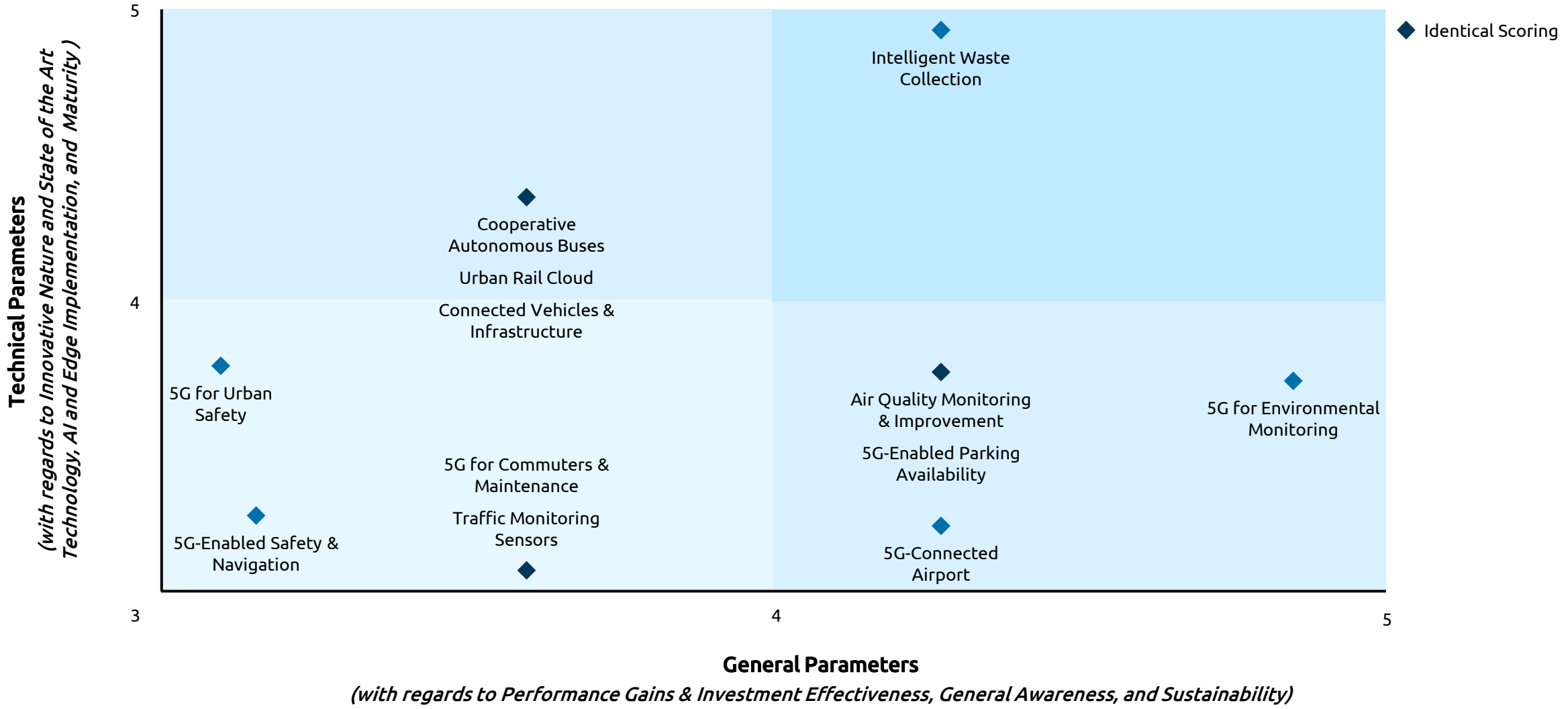
Community Management & Engagement

Governance, Management & Operations

5G use cases in each area of the ecosystem

- 5G Cooperative Autonomous Buses
- Connected Vehicles & Infrastructure
- 5G-Connected Airport
- Urban Rail Cloud
- 5G for Commuters & Maintenance
- Air Quality Monitoring & Improvement
- 5G-Enabled Safety and Navigation
- 5G-Enabled Parking Availability
- 5G for Environmental Monitoring
- 5G-Enabled Traffic Monitoring Sensors
- 5G Intelligent Waste Collection
- 5G for Urban Safety

SMART CITIES USE CASES MAPPING



KT Corp

5G Cooperative Autonomous Buses

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- KT tested two 5G-connected cooperative self-driving electric buses in a smart city complex to develop a service model, with technologies the company has accumulated for years. While self-driving technology allows a vehicle to navigate autonomously to its destination, cooperative autonomous vehicles use vehicle-to-everything (V2X) technology to interact with each other and on-road structures such as traffic lights and pedestrian monitoring devices.

Business Model & Key Actors

- The test buses have been built from scratch in cooperation with Edison Motors, a domestic electric vehicle maker, and Phantom AI, a Silicon Valley autonomous driving technology startup.
- Key actors
  - Network equipment provider: KT Corp
  - System integrator: KT Corp
  - Operator: /

Technical Architecture

- KT applied the real-time kinematic (RTK) positioning satellite navigation technology, which enhanced the precision of position data, as well as a local dynamic map (LDM) and a geographic information system (GIS).

Impacted Areas & Business Value

- Added Value:
  - Reduced traffic jams
  - Higher security through a reduced number of accidents

#UrbanMobility

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#V2X** **#RTK** **#LDM** **#GIS**

NEC Mobility Test Center

5G-Connected Vehicles & Infrastructure

Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- NEC opened its Mobility Test Center, a demonstration facility that utilizes advanced technologies for evaluating automated driving technologies, coordinating infrastructure, and co-creating solutions with partners. It uses data from sensors installed within a city's infrastructure. Infrastructure coordination is a system in which vehicles and roadway infrastructure exchange information quickly and accurately through wireless communications to prevent accidents, alleviate traffic congestion, and more.

Business Model & Key Actors

- While utilizing its own know-how and equipment, NEC conduct various evaluations and verifications aiming to enable infrastructure-coordinated mobility services.
- Key actors
  - Network equipment provider: NEC
  - System integrator: Nokia
  - Operator: /

Technical Architecture

- The NEC Mobility Test Center is equipped with road equipment, such as traffic lights and pedestrian crossings, as well as edge-computing terminals, such as private 5G base stations and C-V2X roadside units. This is in addition to edge-computing equipment, including roadside cameras and edge-processing devices for AI. Moreover, the center features vehicles such as buses and passenger cars, as well as important pedestrian equipment, including electric wheelchairs.

Impacted Areas & Business Value

- Added Value:
  - Creation of safe, secure, and people-friendly cities (prevent accidents, alleviate traffic congestion, support for automated driving, etc)

#Mobility

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IOT **#AI** **#Edge** **#V2V** **#V2I** **#C-V2X**

George Best Belfast City Airport

5G Connected Airport

Commercially Live
Pilot
Potential (Concept)

Start Year – 2021

Context

- The project, rolling out 5G at the airport, set Belfast City Airport on the road to become smart and help to establish its position as an industry leader in the field of IT infrastructure. It provides a huge advantage for passengers, staff and airline partners. It enables the implementation of the next generation in connectivity technology, which boost connection and download speeds across the airport, and enable the building to support everything from intelligent automation to energy efficiency and enhanced security.

Business Model & Key Actors

- Belfast Airport has become one of the most highly connected transport hubs in the UK after signing a contract with digital transformation specialist, Exchange Communications, for the installation of 5G.
- Key actors
  - Network equipment provider: Exchange Communications
  - System integrator: Exchange Communications
  - Operator: /

Technical Architecture

- N/A

Impacted Areas & Business Value

- Added Value:
  - Enhanced customer experience/journey
  - Stimulated energy savings
  - Reinforced security
  - Improved operational efficiency

#Operations **#CustomerExperience**

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#Edge** **#IOT**

Shenzhen Metro Lines

Urban Rail Cloud

Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- Shenzhen Metro Lines 6 and 10 are the first in Shenzhen to benefit from full 5G coverage. With the support of cloud computing and big data technologies, it optimizes service application systems to integrate various information resources. In addition, enhanced integration between subsystems and collaboration between service departments implement information-based management, as well as centralized control throughout the operations process. This in turn effectively eliminates silos.

Business Model & Key Actors

- Based on the urban rail cloud platform and the capabilities of Huawei, Shenzhen Metro has constructed a big data analytics platform.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: China Mobile

Technical Architecture

- Integrated and unified service platform using cloud computing technology. The urban rail cloud uses a big data platform to integrate heterogeneous data resources and mobilize data assets. The platform support line-level data analytics, involving device health, energy consumption management, passenger flow statistics, line center-level monitoring, emergency decision-making, and image-based fire analysis. System operators enjoy comprehensive visualization on one map, where one click provides global awareness, with operations that are linked and integrated.

Impacted Areas & Business Value

- Added Value:
  - Increased platform security by 80%
  - Improved IT resource utilization by 50%
  - Potential footprint cut by about 50%

#Operations **#CustomerExperience**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#BigData** **#Cloud**

Train Station Rennes

5G for Commuters & Maintenance

Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- The project explore various services and use cases that simultaneously meet the needs of passengers (instant media downloads (films, series, documentaries) with FASTPOINT), professionals (video-conferencing on a Lenovo 5G computer), maintenance technicians (immersive assistance with connected glasses by Rennes-based company AMA) and even journalists (filming and broadcasting 4K videos live using Sony devices).

Business Model & Key Actors

- SNCF joined forces with operator Orange and OEM Nokia as part of a call for innovative platforms by Arcep.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: Orange

Technical Architecture

- Orange provide the telecom network services, and Nokia is in charge of connectivity technologies, including private network solutions. The Institut Mines-Telecom, through its Values and Policies of Personal Information Chair look at the notions of trust and sovereignty applied to telecommunications and more specifically the issue of hosting data at the edge of the network (edge computing).

Impacted Areas & Business Value

- Added Value:
  - Improved customer experience
  - Greater security/safety
  - Shorter response time for assistance (no displacement needed)

#Operations **#CustomerExperience** **#Safety**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

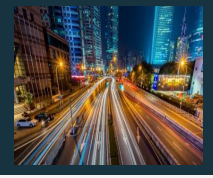
#AI **#IoT** **#AR**

Use Case Type

- **B2B**
- **B2C**

Helsinki City

Air Quality Monitoring & Improvement



Commercially Live
Pilot
Potential (Concept)

Start Year – 2018

Context

- The University of Helsinki and Bell Labs are developing a tool, MegaSense, which uses 5G to generate precise, timely data on air quality. Real-time insights will enable more informed decision-making for cities. A consumer app, GreenPath, is also being created to give citizens visual updates on air quality via their smartphones. They could, for example, plan routes around where air is cleaner, and also engage more closely with air quality levels in their city and what they could potentially do to improve things.

Business Model & Key Actors

- The MegaSense concept is coordinated by the University of Helsinki and applies world class scientific expertise in Atmospheric Science, Computer Science and GeoInformatics.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Nokia
  - Operator: /

Technical Architecture

- The MegaSense programme, enables solutions by gathering and fusing spatially variable gas and particulate measurements from high-end scientific instruments, commercial air quality transmitters, dense low-cost sensor arrays, and consumer wearables utilizing 4G and 5G technologies. The sensor data is bolstered with data from the University of Helsinki's SMEAR research stations in Finland and China, as well as pollution maps and predictive models. All the data is merged and processed over the 5G network.

Impacted Areas & Business Value

- Added Value:
  - Better quality of life
  - Positive health & sustainable impact

#Sustainability

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AI **#IOT** **#Analytics**

Verizon & HERE

5G-Enabled Safety & Navigation - Visual Positioning Services

Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- Verizon and HERE use "co-innovation" for a wide range of enterprise, industrial and consumer-facing use cases, starting with applications related to vehicle and pedestrian safety such as collision avoidance, and better location identification and navigation for ridesharing pick-up/drop-off and delivery services.

Business Model & Key Actors

- Verizon and HERE Technologies have teamed up to create safety and navigational systems based on Verizon's 5G infrastructure and HERE's mapping and artificial intelligence (AI) tools.
- Key actors
  - Network equipment provider: Verizon
  - System integrator: Verizon
  - Operator: Verizon

Technical Architecture

- Verizon's 5G ultra-wideband capabilities is combined with HERE's HD Live Map and Live Sense computer vision technology to create a vehicle-to-network (V2N) communication system. HERE's Live Sense SDK identifies vehicles, pedestrians, bicycles, and barriers from a vehicle-mounted cell phone. This data is then sent to Verizon's 5G edge, where artificial intelligence predicts likely travel paths and warns vehicles of impending potential collisions.

Impacted Areas & Business Value

- Added Value:
  - Increased urban safety & increased mobility experience
  - Reduced number of collisions

#Operations **#Safety** **#UrbanMobility**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness		●	
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- B2B
- B2C

#VPS **#AI** **#Edge** **#IOT**

WM5G

5G-Enabled Parking Availability through App

Commercially Live
Pilot
Potential (Concept)

Start Year – 2021

Context

- Currently, 30% of cars on the roads of West Midlands city centres are searching for available parking. Local authorities are struggling to increase parking availability and reduce congestions in busy urban locations. AppyWay enables to maximise the kerbside by equipping last-mile delivery vehicles or buses with 5G-enabled HD street scanning equipment. Due to 5G's high capacity, low latency, real-time availability of parking spaces can then be monitored across a whole city center.

Business Model & Key Actors

- In partnership with Transport for the West Midlands, WM5G is building better digital and transport links. With the support of parking technology provider AppyWay, a series of trials took place on Stratford Road in Birmingham.
- Key actors
  - Network equipment provider: AppyWay
  - System integrator: /
  - Operator: /

Technical Architecture

- Prior to the trial, a Getmapping survey vehicle was equipped with a roof-mounted HD camera, GPS and a 5G SIM to allow capture and transfer of data during the test. The test area was then mapped with the survey vehicle to create a model for the artificial intelligence to identify and recognize the route and any available parking bays.

Impacted Areas & Business Value

- Added Value:
  - Reduce congestion, improve air quality, more accessible for visitors
  - Parking availability to an app for Quicker driver journey & Less time spent on the road

#Mobility

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

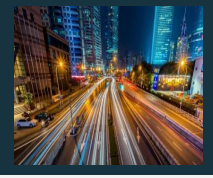
Use Case Type

- B2B
- B2C

#IOT **#AI**

SKYE

5G for Environmental Monitoring - Cameras-Sensors-Equipped Drones



Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- Video from a drone, computer vision and super fast 5G connections have been used to monitor and provide real-time insights into environmental conditions in the Baltic Sea regarding blue-green algae. Drone-shot video, fast connections and real-time AI-driven data analysis in data centers offer significant new opportunities for environmental monitoring. Besides blue-green algae, drones can be used to track the spread of plastic waste or locate oil leaks

Business Model & Key Actors

- Nokia, Telia, Nordkapp, Finnish Environment Institute SYKE, and Vaisala developed new tools for monitoring the environment with 5G.
- Key actors
  - Network equipment provider: Nokia
  - System integrator: Vaisala, Nordkapp
  - Operator: Telia

Technical Architecture

- The camera and sensor-equipped drone was flown over the Baltic Sea, and the high-resolution video was transmitted over 5G for real-time analysis. Blue-green algae monitoring is based on multiple sources of information, including satellite imagery and automated chlorophyll measurements from ferries sailing the Baltic Sea. This data was combined with local visual observations made at the shoreline.

Impacted Areas & Business Value

- Added Value:
  - Real-time insights & situational awareness for quicker decision and prevent environmental hazards
  - Solutions to global societal pressing needs and challenges

#Sustainability

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability	●		
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IOT **#AI** **#Analytics** **#ComputerVision**

WM5G

5G Enabled Traffic Monitoring Sensors

Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- Vehicle counting sensors with 5G connectivity have been installed on two roads with a high variety and density of traffic and allowed the application of live-traffic tracking to be trialled. Thanks to the data gathered, state-of the art prediction models can be developed to more accurately forecast traffic flow and reduce congestion in hot-spots.

Business Model & Key Actors

- WM5G partnered with smart sensor provider Vivacity Labs, to validate the application and the use of 5G-enabled smart sensors to accurately identify and classify road usage in real-time.
- Key actors
  - Network equipment provider: Vivacity Labs
  - System integrator: /
  - Operator: /

Technical Architecture

- Lamp posts were equipped with Vivacity smart sensors powered by 4G and 5G connectivity to compare the capability of each network generation. The solution involved Vivacity's edge processing with video streaming, only in use when a live incident is identified. Vivacity algorithms automatically blur personal data from the footage to ensure the highest level of privacy. Then, it can efficiently respond to traffic incidents while mitigating any potential data privacy risks.

Impacted Areas & Business Value

- Added Value:
  - Improved road safety, traffic flow and incident reporting, and build predictive models

#Mobility **#Saftey**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

B2B

B2C

#IOT **#Edge** **#ML**

Universitat Politècnica de València (UPV)

5G Intelligent Waste Collection - Autonomous Vehicles & Smart Containers

Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- Last-mile logistics and municipal waste collection take a major step forward with developments incorporating 5G mobile technology, robotization, and big data. The application of Advanced Urban Delivery and Refuse Recovert (AUDERE) implies a reduction in the transit of trucks or vehicles (both garbage trucks and parcel delivery trucks) in the urbanizations, reducing environmental and noise pollution and improving the quality of life of the neighbours.

Business Model & Key Actors

- Orange, Fivecomm, Robotnik, Mosaik Urban Systems and Industrias Alegre are designing and developing an intelligent system to automate urban waste collection, and logistics in the delivery of goods and parcels.
- Key actors
  - Network equipment provider: Fivecomm
  - System integrator: Fivecomm
  - Operator: Orange

Technical Architecture

- The pilot makes use of two RB-VOGUI robots (connected to 5G network), which allow the transport of smart containers, both for municipal waste and for parcels, to their consolidation center (emptying and/or filling), depending on their use case. In particular, two use cases will be validated: (1) municipal waste collection, and (2) asynchronous and synchronous delivery of parcels to end users.

Impacted Areas & Business Value

- Added Value:
  - Optimized of pick-up routes
  - Reduced CO2 emissions
  - Incentivized waste reduction and packaging reduction (pay-as-you-throw)

#Administration **#Sustainability**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability	●		
Innovative Nature	●		
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IOT **#AI** **#Robotics** **#BigData**

Seoul City

5G for Urban Safety with Sensors for Jaywalkers Prevention

Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- Seoul and SK Telecom's developed "cooperative-intelligent transport systems" by using 5G sensors and car telecommunications to warn the latter of jaywalkers, as well as to pave the way for ambulances. 5G have a response time of 0.01 second allowing drivers to respond quicker to danger. For example, 5G sensors detect a jaywalker and alter nearby automobiles. Automobiles are also warned when an ambulance is nearby, and of collisions ahead or potholes created in monsoons.

Business Model & Key Actors

- Seoul and SK Telecom develop "cooperative-intelligent transport systems" that utilise 5G and car telecommunication to increase safety.
- Key actors
  - Network equipment provider: Samsung Electronics
  - System integrator: SK Telecom
  - Operator: SK Telecom

Technical Architecture

- Seoul and SK Telecom installed 5G and sensors at major roads in South Korea's capital. They also supplied 5G Vehicle-to-Everything (V2X) handsets to 2,000 buses, taxis, and traffic lights. The handsets have been co-developed by SK Telecom and Samsung Electronics. The installation of the handsets allow buses and taxis to communicate with traffic lights. Then, a control center analyzes the data from the communications and send a warning to the vehicles when there is danger.

Impacted Areas & Business Value

- Added Value:
  - Ease of movement for emergency services
  - Enhanced road & citizens safety

#UrbanMobility **#Saftey**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness		●	
Sustainability		●	
Innovative Nature		●	
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IOT **#AI** **#V2X**

PUBLIC ADMINISTRATION

The government is trying to satisfy the citizens' thirst for digitalization, at the risk of being disconnected, through the implementation of tools - e.g., MyPension, Tax-on-web - that are still minor transformations.

NATIONAL ACCOUNTS

Value Added *(Euro, Millions)*
16,378

Labour input *(Persons, thousand)*
221

Gross Fixed Capital Formation *(Euro, Millions)*
2384

Gross Fixed Assets *(Euro, Millions)*
50,782

CHALLENGES

Managing technological changes

The modernization of archaic systems and processes to improve efficiency of service delivery while considering cybersecurity and data policymaking practices.

Develop environmentally sustainable operations

The environmental policy is an international issue that requires broad-based cooperation.

Changing behaviors and demand

The citizens expect to be able to access public information more easily, quickly and regularly - digitally or not.

TRENDS

8.4% Of 856 FPS Policy and Support staff members are “e-gov” functions, which deals with the digital transformation dimension.

10% of the working population are employed in the public sector, which includes all public services, public institutions and public education; i.e., a reduced portion of the latter for public administration

79% Of government officials acknowledge that automation positively impacts their activity

CULTURE

The second pillar of the "Brain-Be 2.0" initiative intends to engage and expand scientific expertise to support conservation, access (including new ICT tools), interpretation and management of the legacy.

NATIONAL ACCOUNTS

Value Added *(Euro, Millions)*
1239

Labour input *(Persons, thousand)*
18

Gross Fixed Capital Formation *(Euro, Millions)*
288

Gross Fixed Assets *(Euro, Millions)*
5416

CHALLENGES

Economic downturn

The impact on financial of the industry, and especially the funding, are not negligible; governments and sponsors have cut grants.

Rise of the corporate ethos

The need to emulate organizations for profit to sustain and enhance competitiveness in an increasingly challenging environment.

Grasping the digital revolution

The transition opens up new and potentially very beneficial opportunities/windows - remote art showing, creative art activities, etc.

TRENDS

€3.5+M have been invested in the three federal museums in order to carry out their respective transformations, to undertake digitalization and to make energy savings.

20+ projects are included in the "Brain-Be 2.0" experiment, one of which includes high-tech laboratories (3D microscope, spectroscopy, radiography, etc.) and another with the ambition to improve the ICT infrastructure to facilitate data-level access through an interdisciplinary collaboration between cultural heritage experts, digital humanities researchers and data scientist.

PUBLIC ADMINISTRATIONS & CULTURE ECOSYSTEM

Community & Culture Management

Public & Private Infrastructure Management

Legislation & Regulation

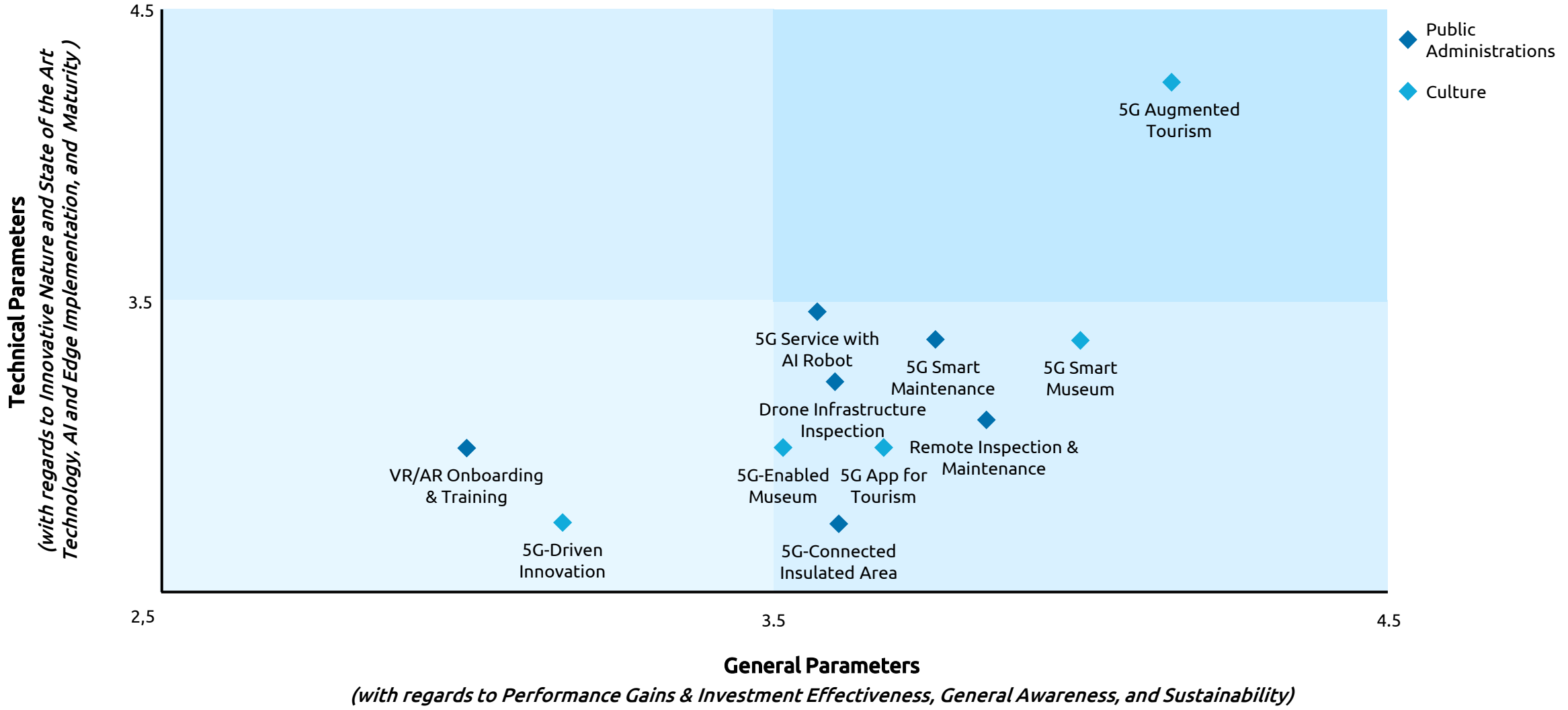
5G use cases in each area of the ecosystem

- AR for 5G Smart Tourism
- 5G-Driven Innovation
- 5G-Powered Smart Museum
- 5G Augmented Tourism
- 5G-Enabled Museum
- Drone Infrastructure Inspection
- 5G Smart Maintenance
- 5G Service with AI Robot
- 5G Remote Inspection & Maintenance
- 5G Connected Insulated Area
- VR/AR Onboarding & Training

$Note_1$: The public administration and culture sectors were merged for the ecosystem analysis and the repository section for consistency. However, the use cases are distinctly indicated by the sectoral affiliation image.

$Note_2$: Some cases belonging to the public administration sector may be similar to solutions specific to other industries (e.g., transport & logistics, or manufacturing). They are however to be regarded in circumstances specific to infrastructures directly or indirectly related to the public (e.g., railway infrastructures of the SNCB for inspections and maintenance)

PUBLIC ADMINISTRATIONS & CULTURE USE CASES MAPPING



Changdeokgung Palace

5G-Powered AR App for Tourism

Commercially Live
Pilot
Potential (Concept)

Start Year – 2021

Context

- To make tourist experiences interactive, the Changdeokgung Palace implemented alternative reality technology to enhance visitor experiences by watching a royal court dance performance, playing Korean traditional games in AR, and taking AR pictures. While the current app targets only physical visitors, SK Telecom plans to introduce a new app for those who cannot physically visit the palace. It could allow anyone around the world to take a tour of the palace through different AR and VR platforms.

Business Model & Key Actors

- SK Telecom in collaboration with the country's Cultural Heritage Administration has launched 'Changdeok ARirang,' an AR app based on 5G edge cloud. It was developed in partnership with Google, Nexus Studios, and Seerslab.
- Key actors
  - Network equipment provider: SK Telecom
  - System integrator: SK Telecom
  - Operator: SK Telecom

Technical Architecture

- Changdeok ARirang AR app is built by leveraging Google's Cloud and AR platform ARCore, as well as other latest AR technologies including 'lighting estimation' and 'cloud anchor'. The app is designed to deliver a 5G-based AR experience with ultra-low latency data communication.

Impacted Areas & Business Value

- Added Value:
  - Increase attractiveness of the country
  - Creative cultural experience

#CustomerService

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#AR **#VR** **#Edge**

KTH Royal Institute of Technology

5G-Driven Innovation - Innovation & Research Platform

Commercially Live
Pilot
Potential (Concept)

Start Year – 2018

Context

- KTH has grown to become one of Europe's leading technological universities and a center for talent and innovation. The university is Sweden's largest technical research institution and home to national strategic research within E-science and IT and mobile communication. The 5G network's fast connectivity and low latency is aimed to attract partners, start-ups and tech-scientists interested in testing and developing new services and business models using Telia and Ericsson's 5G platform.

Business Model & Key Actors

- Telia Company, Ericsson and KTH Royal Institute of Technology launched a 5G network on the KTH campus in Stockholm that serve as an innovation and research platform for the academia and partner companies.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: Telia

Technical Architecture

- The 5G network on the KTH campus serve as a platform for innovation and research within vital areas such as autonomous transportation, Internet of Things (IoT), smart buildings and city infrastructure, industry automation and remote VR. This is the first 5G network on air in Sweden based on 3GPP standards and using commercial 5G products from Ericsson.

Impacted Areas & Business Value

- Added Value:
  - Increase the number of innovative solutions and services
  - Accelerate digitalization of industries and society at large

#Administration

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability			●
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- **B2B**
- **B2C**

#IOT **#VR**

Palace Museum/Forbidden City

5G-Powered Smart Museum through High-Tech & Connectivity

Commercially Live
Pilot
Potential (Concept)
Start Year – 2020

Context

- The museum has developed an app that provides in-depth interpretation of cultural relic information and cultural services, with a total of more than six million downloads. In the meantime, the museum has research on the application of VR, AR, AI and other technologies in learning & cultural environments. It accumulated rich digital resources of ancient buildings and cultural relics. The two proposals of the app set an example for 5G application, creating a smart cultural heritage.

Business Model & Key Actors

- The Palace Museum signed a strategic cooperation agreement with Huawei in the Forbidden City to build a digital and smart museum.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: Huawei

Technical Architecture

- Under the agreement, 5G Wi-Fi signals cover the 720,000-square-meter compound, China's imperial palace and the branch museum of the institution under construction in northwestern Beijing. It support it to become a high-tech-backed Palace Museum that presents visitors faster network speeds, high-definition video content, as well as instant display of information about ancient buildings and cultural relics displayed in the Palace Museum.

Impacted Areas & Business Value

- Added Value:
  - Better visitor experience
  - Operational efficiency (storage, restoration, transportation,…)
  - More comprehensive platform for education

#CustomerService #Operations

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability			●
Innovative Nature		●	
AI & Edge	●		
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- B2B
- B2C

#AR #Cloud #AI #CCTV

Ajuntament de Valencia & Prensa Iberica 360°

5G Augmented Tourism - AR Glasses for Cultural Guided Visits

Commercially Live
Pilot
Potential (Concept)
Start Year – 2018

Context

- The use of 5G technology in tourism can improve the experience of tourists based on their position, orientation and profile. In Valencia, an enriched tourist experience can be enjoyed in the Town Hall square which, thanks to 5G and augmented reality, allows the superimposition of digital images and additional content in real environments. Residents and visitors can discover details of the history of the most emblematic places in the city of Valencia using mixed reality glasses and mobile devices.

Business Model & Key Actors

- Orange, Huawei and Visyon are collaborating on the project for the Valencia City Council and Prensa Ibérica, which allows tourists to discover the history of each of the selected locations in AR.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: /
  - Operator: Orange

Technical Architecture

- The tour is presented by a host, who, using AR glasses, displays the content around the participants with gestures. Unlike other AR guides, the quality of the content is multiplied thanks to rendering in the cloud. A dedicated server is able to create the images based on the position of each smart device and send them with total immediacy in order to create an augmented experience of the highest level, taking advantage of the speed of the 5G network in the city of Valencia.

Impacted Areas & Business Value

- Added Value:
  - Unique cultural experience anywhere at any time
  - Multiplied quality of content

#CustomerService

	High	Medium	Low
Performance & Investment Gains	●		
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge	●		
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

- B2B
- B2C

#MR #IoT #Cloud

National Museum of China

5G-Enabled Museum - Comprehensive Smart Solutions for Museum

Commercially Live
Pilot
Potential (Concept)
Start Year – 2019

Context

- The National Museum of China wants to become smarter. With more than 6,000 relics on display, the museum is China's grandest and most popular museum. And, like every other part of the country, it is eager to jump in on the tech revolution. 3 ways are co-existing with 5G-enabled solutions to improve its services: personalized environments for cultural relics and their preservation, improving visitor experience, and museum security.

Business Model & Key Actors

- The museum has engaged the help of Huawei's 5G technology to implement ICT infrastructure and smart devices, all so the museum can "proactively identify customers' needs".
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: China Mobile

Technical Architecture

- On one hand, the warehouses where the relics are stored are constantly monitored for their humidity, temperature and the presence of hazardous substances in the air. On the other hand, the museum uses smart devices to tailor customer experiences. Finally, it also uses facial recognition technology across its grounds to ensure that "suspects have no hiding place".

Impacted Areas & Business Value

- Added Value:
  - Easier storage management
  - Improve visitor experience (elevators, car parks, lighting,…)
  - Energy usage optimization
  - Better security

#CustomerService #Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

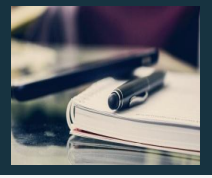
B2B

B2C

#IOT #4D #AR #VR #AI #Analytics

Adif

Drone Infrastructure Inspection



Commercially Live
Pilot
Potential (Concept)

Start Year – 2021

Context

- The service allows a drone outfitted with high-resolution cameras and a 5G modem to be remotely piloted to gather images of the railways and transmit them in real time. These images are processed with AI, making it possible to automate track inspection. The use case also includes an application for virtual reality Oculus glasses that allows integrated viewing of the images from the inspection camera and the drone telemetry data in a single device with a 360° view, thus enriching the remote inspection work.

Business Model & Key Actors

- Telefónica defined and developed the E2E solution; Ineco developed the drone's on-board systems, the BVLOS control and the AI; Huawei provided the 5G and computing infrastructure.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Telefonica
  - Operator: Telefonica

Technical Architecture

- 5G coverage has been deployed on two railway routes, each approximately 10 km long and a drone was outfitted with 5G connectivity and multiple cameras: one with 360-degree vision, another for inspection with 4K resolution and a powerful zoom, and a third for BVLOS remote piloting. In addition, the AI algorithm housed in the edge (computing capacity located inside Telefónica's network) is capable of detecting different track elements by recording their position

Impacted Areas & Business Value

- Added Value:
  - Simpler, safer and less frequent inspections
  - Cost savings from predictive maintenance

#ProcessControl

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

#AI **#VR** **#AR**

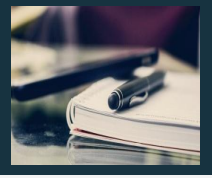
Use Case Type

B2B

B2C

CSP Spain & Ajuntament de Valencia

5G Smart Maintenance - Remote Expert Support



Commercially Live
Pilot
Potential (Concept)
Start Year – 2022

Context

- Thanks to 5G, the coordination and smooth operation of different services with staff located in different locations is possible. The smart expertise project enables staff to share video/audio in real time, with augmented reality functions, for the resolution of doubts and incidents. The field operator is assisted by the expert side, receiving precise instructions via AR pointer or visualizing documents, images, videos and any other information necessary for the performance of their tasks.

Business Model & Key Actors

- Orange and Huawei collaborate with the intelligent maintenance company Suigéneris, for the City Council of Valencia and CSP Spain creating a remote assistance platform.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: Huawei
  - Operator: Orange

Technical Architecture

- The use case is located in a rural environment with predominantly productive and industrial activity. The packet core has been implemented in a central location (not distributed). The proposal is to deploy new 5G coverage in the area of Castro de Rey (Lugo), by installing a 5G node (gNodeB), co-located with an LTE node (eNodeB) serving this area.

Impacted Areas & Business Value

- Added Value:
  - Immediate remote assistance with greater accuracy
  - Shorter response time
  - Cost reduction
  - Indirect environmental impact

#Operations

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity		●	

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- **Ultra-reliable low latency comms.**
- Massive machine-type comms.

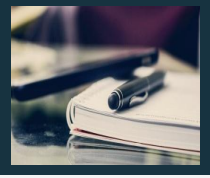
#AR **#Cloud** **#RealTimeVideo**

Use Case Type

- **B2B**
- **B2C**

KT Corps

5G Assisted Services - Smart Robot



Commercially Live
Pilot
Potential (Concept)

Start Year – 2018

Context

- KT Corporation has launched its 5G network commercial service through an AI-equipped robot named Lota, marking a new era of innovation in the world's information and communications technology (ICT) sector. The robot guided visitors through the Seoul Sky Observatory, which sits on top of the landmark 123-storey, 555-meter-high Lotte World Tower in eastern Seoul.

Business Model & Key Actors

- KT selected an AI robot as its first customer to symbolize its new 5G network service. The company plans to expand into new businesses, using intelligent machines and B2B operators.
- Key actors
  - Network equipment provider: KT Corp
  - System integrator: KT Corp
  - Operator: KT Corp

Technical Architecture

- Because of KT's Internet backbone with full mesh topology and edge communication centers based on control and user plane separation (CUPS) technology, its 5G service with ultra-low latency is uniquely advantaged over other carriers. Full mesh topology is an up-to-date technology in which every node in the network has a circuit connection to every other node. CUPS is an advanced architecture enhancement technology indispensable for SA-based networks of 3GPP standards.

Impacted Areas & Business Value

- Added Value:
  - First step towards commercial adoption of 5G
  - Operational efficiency
  - Assistance in all repetitive tasks to free up skilled labor

#Operations **#CustomerService**

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness	●		
Sustainability		●	
Innovative Nature	●		
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

Use Case Type

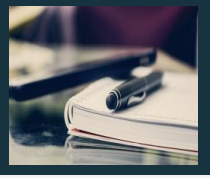
B2B

B2C

#AI **#Robotics**

Viesgo & Generalitat Valenciana

5G Remote Inspection & Maintenance



Commercially Live
Pilot
Potential (Concept)
Start Year – 2021

Context

- 5G technology enables remote inspection and maintenance work to be carried out in infrastructures that are difficult to access. The aim of this pilot is to test the application of robots in inspection and maintenance tasks in critical areas such as electrical and railway infrastructures, where a very high level of reliability and safety is required.

Business Model & Key Actors

- Orange and Huawei, collaborate with Robotnik and iTeam, to perform inspection and maintenance of electrical and railway infrastructures.
- Key actors
  - Network equipment provider: Huawei
  - System integrator: iTEAM
  - Operator: Orange

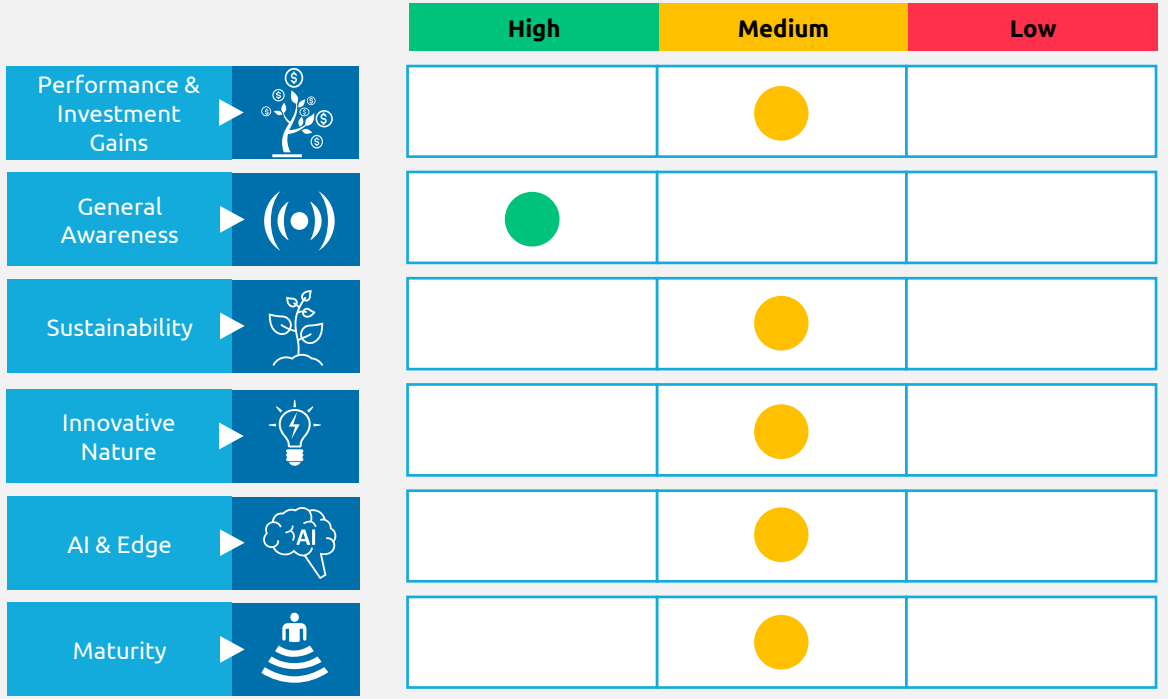
Technical Architecture

- Testing is being carried out at the Universidad Politécnica de Valencia (UPV) campus, while the validation occurs at the Generalitat Valenciana facilities (in the vicinity of the campus). Remote control of the robots in difficult terrain requires high information transmission capacity (high quality images) and ultra-low latency. In addition, as this is a critical system, a very high level of reliability and security is required.

Impacted Areas & Business Value

- Added Value:
  - Reduced risk of occupational accidents
  - Allowed inspection of inaccessible areas
  - Shortened response time
  - Maximum reliability & safety

#ProcessControl **#Saftey**



Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
- Massive machine-type comms.

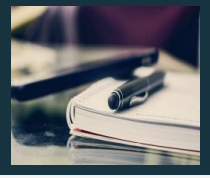
Use Case Type

- **B2B**
- **B2C**

#IoT **#Edge** **#AI** **#Robotics**

Taesung Freedom Village

5G-Connected Insulated Area



Commercially Live
Pilot
Potential (Concept)

Start Year – 2019

Context

- The next generation technology is available in the South Korean community in the 4-km wide Demilitarized Zone, that former U.S. President Bill Clinton once called “the scariest place on Earth”. The 200 residents - who live only 400 meters (437 yards) from a border guarded by heavily-armed soldiers, barbed wire and anti-tank barricades - cannot leave their homes or work in the fields without a military escort. The new technology could give access to an easier life because villagers could have access to remote activities without the need for an escort.

Business Model & Key Actors

- South Korean mobile carrier KT Corp launched 5G services in one of the world’s most heavily armed border zones separating the two Koreas.
- Key actors
  - Network equipment provider: KT Corp
  - System integrator: KT Corp
  - Operator: KT Corp

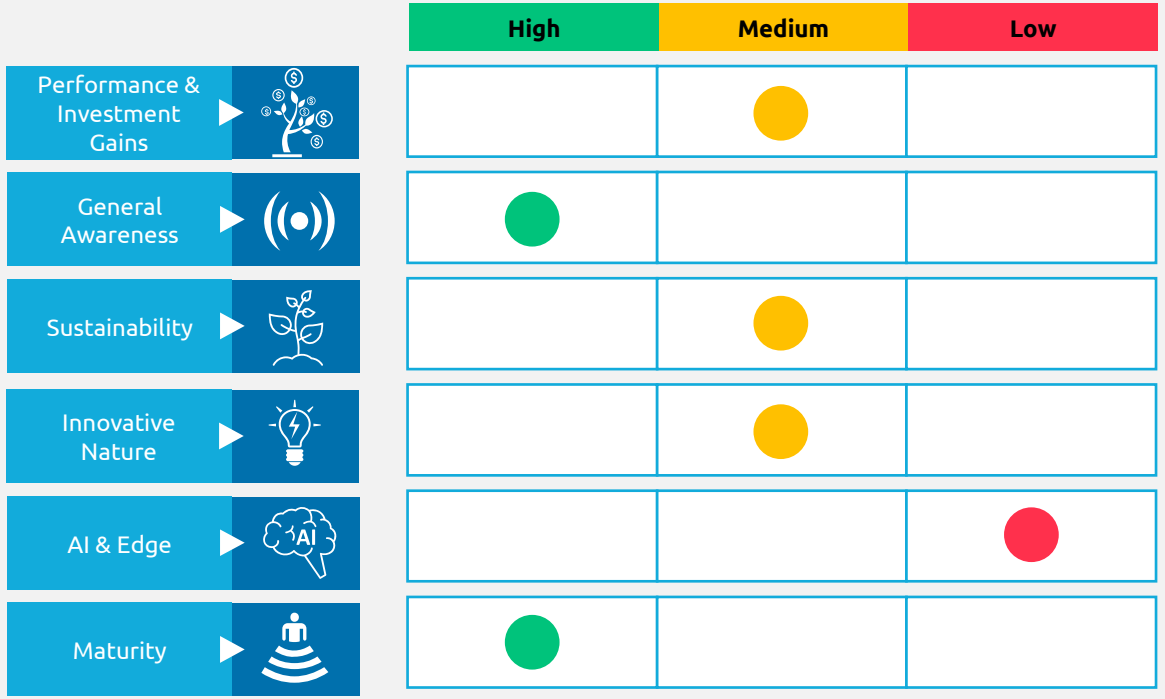
Technical Architecture

- KT Corp installed two 5G base stations across the village. South Korea’s intelligence service tested the 5G stations to ensure network signals do not cross the border. The technology can offer 20-times faster data speeds than 4G long-term evolution (LTE) networks and better support for artificial intelligence and virtual reality with low latency. However, network speeds may be slow inside the village school which is heavily protected against stray bullets.

Impacted Areas & Business Value

- Added Value:
  - Better access to online services
  - Better life quality (access to emergency response for a city without hospital or police station)

#CustomerService



Functional drivers of 5G that facilitate the initiative

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- Massive machine-type comms.

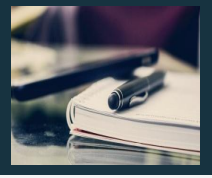
Use Case Type

- B2B
- B2C

#5GNetwork

Ericsson

VR/AR Onboarding & Training



Commercially Live
Pilot
Potential (Concept)

Start Year – 2020

Context

- Ericsson launched its 5G Smart Factory where its engineering professionals are trained with almost no face-to-face interaction. By utilizing the power of virtual reality (VR) in the months prior to opening, new Ericsson employees were able to learn directly from peers in the company's Tallinn smart factory. The approach enabled Ericsson to staff and open the complex to the target timeline and be operational from day one – without the need for new foreign factory employees to travel to other locations for face-to-face onboarding.

Business Model & Key Actors

- From a classroom in Dallas, Texas, the future USA 5G Smart Factory professionals joined their colleagues 8,000km away in Estonia.
- Key actors
  - Network equipment provider: Ericsson
  - System integrator: Ericsson
  - Operator: /

Technical Architecture

- An Improvement Manager at the Tallinn factory participated live as an avatar on top of pre-recorded content for a 360° guided tour of the Tallinn production site, taking questions, while the Head of Operations at the Tallinn factory and the Head of People at the facility, oversaw the guided tour. Plans are in place to develop the collaboration and knowledge sharing through 5G connectivity.

Impacted Areas & Business Value

- Added Value:
  - Operational Efficiency
  - Positive environmental impact – reduced travel
  - Standardized & scalable training (equitable access to upskilling opportunities)

#HR

	High	Medium	Low
Performance & Investment Gains		●	
General Awareness		●	
Sustainability		●	
Innovative Nature		●	
AI & Edge		●	
Maturity	●		

Functional drivers of 5G that facilitate the initiative

- Enhanced mobile broadband
- Ultra-reliable low latency comms.
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#AI **#VR**

Use Case Type

- **B2B**
- **B2C**

APPENDICES

I. Why investigate 5G abroad?

II. How has 5G been deployed?

III. What are the forces of the Belgian industry?

THE STUDY PROVIDES AN OVERVIEW OF FOREIGN 5G SUCCESS STORIES THAT CAN SERVE AS AN INSPIRATION FOR THE BELGIAN MARKET

What is the rationale for this report?

CONTEXT

- Due to circumstances, **Belgium is late in awarding licenses** for 5G. However, this allows to learn from other countries where 5G initiatives have already been successfully rolled out and to draw lessons from them.
- This order is part of the **initiative of the Minister of Telecommunications to invest a cumulative 24 million euros** over the next 3 years in the rollout of 5G demonstration projects.
- **Operators** and other parties will be able to submit proposals, which will be **eligible for co-funding.**

PROJECT OBJECTIVES

- Create an **overview of the successful 5G initiatives** within mainly other EU member states, and in particular within the domains that fall under the competence of the federal government.

- When selecting/framing the different foreign examples, it is important to take into account the themes **where Belgium already has a strong position** and/or which represent an important value for the country and where the introduction of **5G can be an important catalyst.**

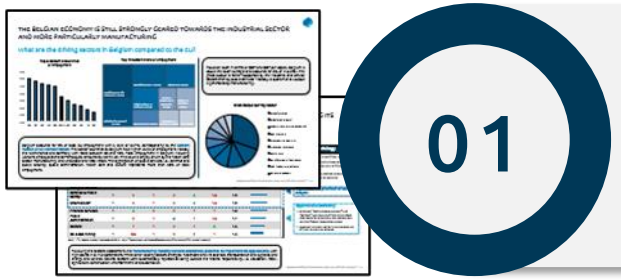
- The end result is a **report including best practices and successful examples** from abroad that also indicate where Belgium can distinguish itself.

VISION

Build a **powerful & leverageable tool at the national & global level**

A 3-STEP APPROACH HAS BEEN PERFORMED TO ENABLE THE USE CASE SELECTION PROCESS

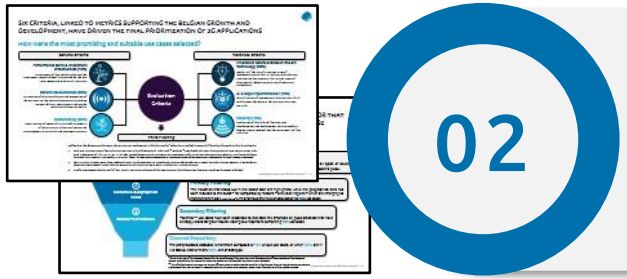
What was the approach and methodology?



01

Sectoral and Geographical Focus

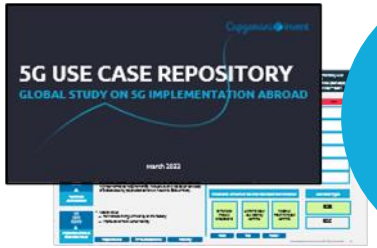
- Sectoral prioritization based on the federal dependence and five ranking parameters
- Geographical restriction to the EU28 – for comparability reasons, Asian regions and the United States (to a lesser extent)* – which are emerging as frontrunners in 5G



02

Use Case Collection, Categorization, Filtering, and Refinement

- Development of an extended 5G use case database
- From a long list towards a short list based on the sectoral and geographical focus, the deployment status, and six selection criteria (Performance & Investment Gains, General Awareness, Sustainability, Innovative Nature, AI & Edge Component, Maturity)



03

Findings and Results Consolidation

- Reunification and aggregation of collected information (by sector, type of use cases, network equipment provider and system integrator, benefits, etc)
- Synthesis and reporting via a standardized format for easy understanding of major differences and easy replication

**The US is not one of the prioritized regions for the identification of use cases due to its fundamentally different conditions from European regions. Nevertheless, the country has some very robust and non-negligible use cases as good examples.*

I. Why investigate 5G abroad?

II. How has 5G been deployed?

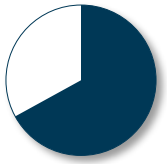
III. What are the forces of the Belgian industry?

COUNTRIES THAT WANT TO STAY COMPETITIVE IN THE GLOBAL ECONOMY ARE SEIZING THE 5G MOMENTUM

What is the current status of 5G?

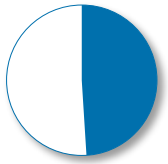
	CHINA	SOUTH KOREA	JAPAN	US	EU27
5G base stations	916,000	162,000	50,000	50,000	112,000
Population	1,402M	52M	126M	330M	448M
People/base station	1531	319	2516	6590	3988
Subscriber numbers	173M	17M	14M	15M	8M
Population reached	12%	33%	11%	5%	2%

The **number of 5G base stations is 8 times higher in China than in the EU**, and this gap rises to 18 times greater when compared to the US. The **ratio of the number of 5G base stations to the population leads to a 13-fold difference between South Korea and the EU**, as well as a 20-fold difference when the US is regarded.

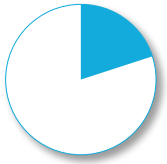


67%
Of users claim that 5G meet or exceed their expectations

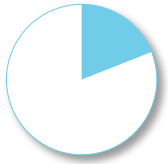
58%
Of pioneer bands assigned in the EU27



49%
Population coverage achieved by end of 2021 in EU27



20%
5G in total connections by end of 2025



19.3%
Of 5G base stations compare to existing 4G base stations

500M 5G connections worldwide

112,500 5G base stations in the EU27

3,988 Average number of people per 5G base stations deployed (EU27)

27 Number of Member States in which commercial 5G services are available

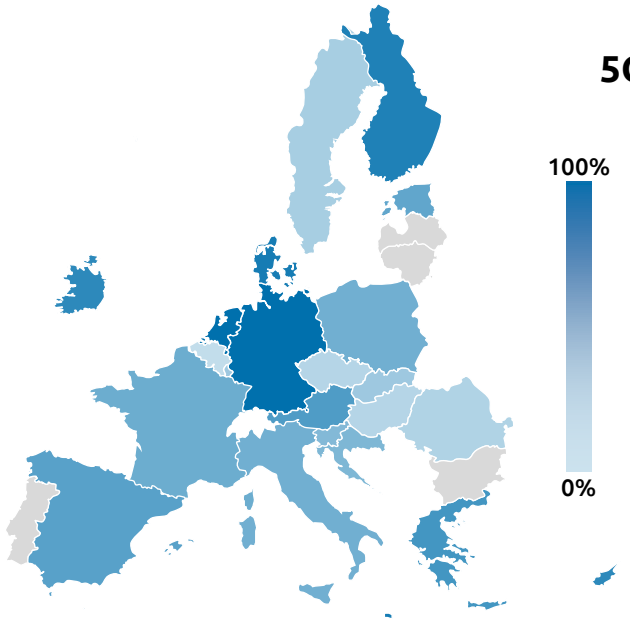
Source: 5G European Observatory, GSMA

DESPITE A FEW FRONTRUNNERS IN 2018, INCLUDING CHINA, THE HEART OF 5G DEPLOYMENT OCCURRED IN 2020

	Pre-2018	2018	2019	2020	2021	2022
STANDARDS		**Rel-15 (NSA)** 5G Speed & 4G Core Network	**Rel-15 (SA)** 5G Core Network Core slicing & Terminals	**Rel-16** Massive IoT, URLLC, Slicing, MCPTT	**Rel-17** IOT (NR light), Slicing (RAN), C-V2X, Direct Mode	**Rel-18** 5G Advanced (AI, ML, NTN, MIMO, UAV,...)
EU INITIATIVES	5G Action Plan (2016) Gigabit Society (2016)	European Electronic Communications Code		EU Toolbox for 5G Security Connectivity Toolbox	EU Digital Decade 2030 Digital Compass	
ROLLOUT & OPERATORS						5G COMMERCIAL SERVICES IN ALL EU27 MEMBER STATES

SINCE ITS ROLLOUT SEQUENCE, THE TECHNOLOGY IS GAINING TRACTION AND BECOMING MORE ESTABLISHED WITHIN THE EUROPEAN UNION

Beyond the launch, how has 5G spread?



5G Population Coverage

100%

0%

Key increases since 2020 (in pp*)

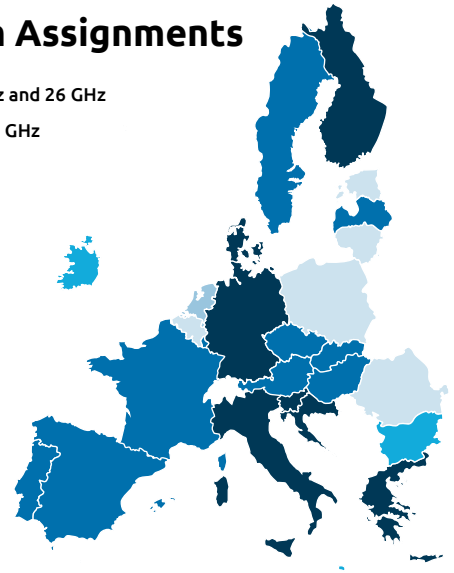
- Malte (80%), Germany (72%), Cyprus (70%), Finland (64%), Greece (60%), Estonia (47%)
- France (42%), Ireland (39%), Spain (38%), Italy (32%), Slovenia (32%), Poland (30%)
- Luxembourg (20%), Netherlands (10%), Slovakia (20%)

While almost **half (49%) of the total EU population is covered** on average, there are **substantial disparities** between the different Member States. Indeed, almost the entire German population is covered by 5G (90%), while in its neighboring country, Belgium, only **4% of the population** has been covered in 2020 and no change has occurred in 2021. The other **border countries** to Belgium emerge as much **more widely covered** as well; 90% for the Netherlands, 42% for France, and 20% for Luxembourg.

Within the European Union, the **3.6 GHz band appears to be the most frequently assigned** band since it appears in 78% of countries. In contrast, the **26 GHz band seems to be weak in popularity** since it has been assigned by only 7 of the member countries, i.e., a fourth of the Union. Overall, there are still 5 countries, including Belgium, that have **not yet assigned any of the pioneer bands**. **Internationally**, notably in the US and Asia, on the one hand, 5G deployment is being established across the **mid-band spectrum** - similarly to the EU.

5G Spectrum Assignments

- 700MHz, 3.6 GHz and 26 GHz
- 700 MHz and 3.6 GHz
- 700 MHz only
- 3.6 GHz only
- None assigned



	LB	MB	HB
China	✓	✓	✗
South Korea	✗	✓	✓
Japan	✗	✓	✓
US	✓	✓	✓

***LB**: Low-band (< 1 GHz); **MB**: Medium-band (1-6 GHz); **HB**: High-band (> 6GHz)*

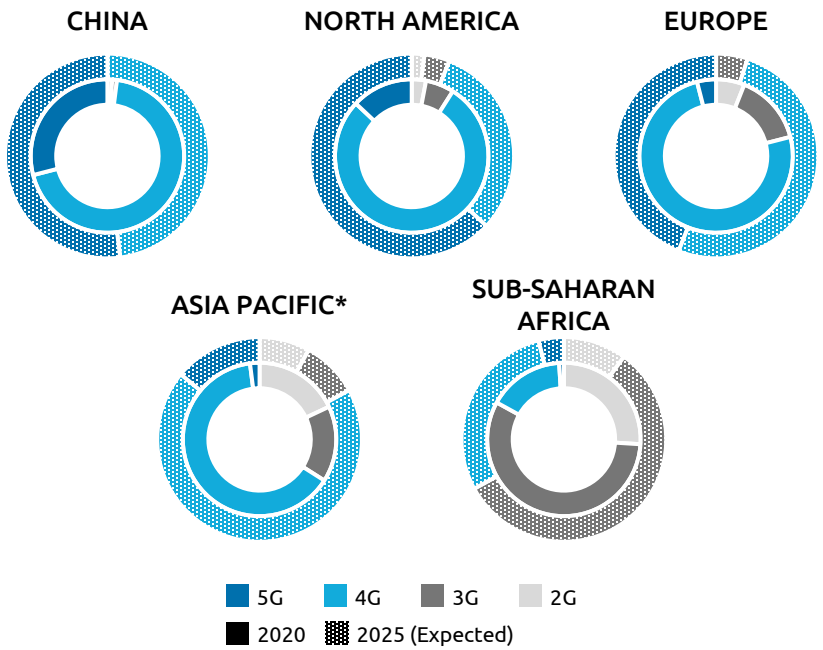
**pp: percentage points*

Source: 5G European Observatory

NONETHELESS, CHINA REMAINS THE FRONTRUNNER IN 5G, TRANSITIONING FAR MORE INTENSIVELY THAN EUROPE OR NORTH AMERICA

What is the penetration threshold of 5G?

Technology Mix



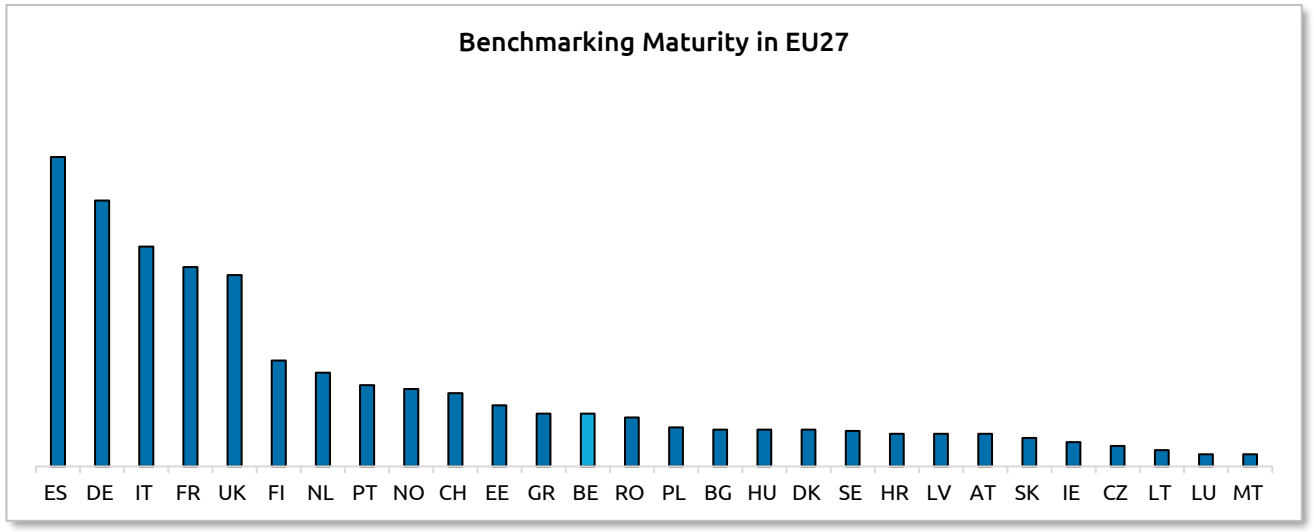
The most widespread technology currently in use is 4G, but a **shift towards 5G is expected by 2025**, especially in the more developed regions and the major powers (China, North America, Europe). The Pacific Asia is following the transition, but at a less intensive pace. Africa is missing the trend and still relies mostly on 3G at present and would only catch the 4G milestone by 2025.

** Except China, Hong Kong, Macau, and Taiwan.*

Maturity Assessment

Maturity is defined by a ratio derived from the weighted average between the number of trials and pilots identified and their respective individual maturity.

The top countries in terms of readiness/maturity, i.e., Spain, Germany and Italy, stand out as **five to six times more advanced than Belgium**. The latter is in thirteenth position among the members of the European Union. At the bottom of the list is Lithuania, the last EU country to deploy 5G, which is nevertheless considered slightly more mature than Luxembourg and Malta.



Source: 5G European Observatory, GSMA

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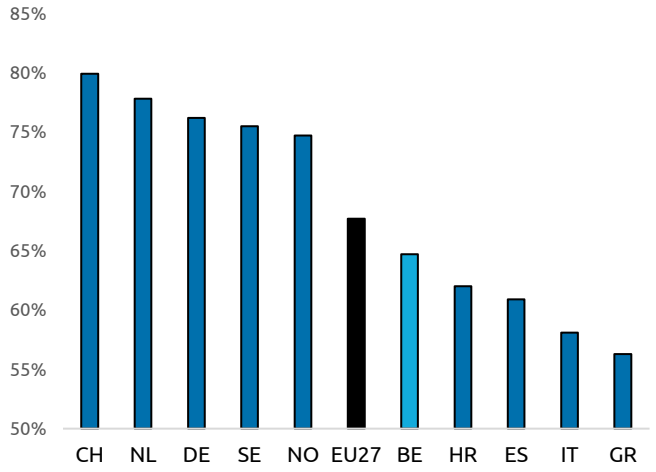
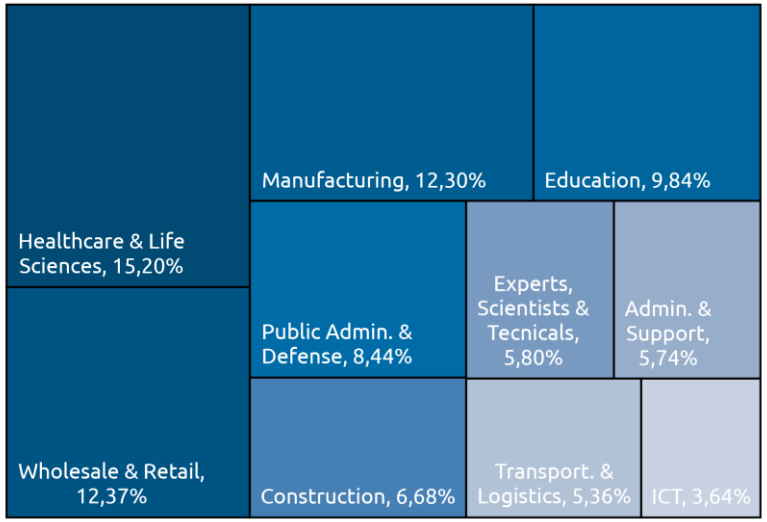
THE BELGIAN ECONOMY IS STILL STRONGLY GEARED TOWARDS THE INDUSTRIAL SECTOR AND MORE PARTICULARLY MANUFACTURING

What are the driving sectors in Belgium?

Top & Bottom 5 Countries of Employment (EU27)



Share of Sectors in Total Employment in Belgium* (%)



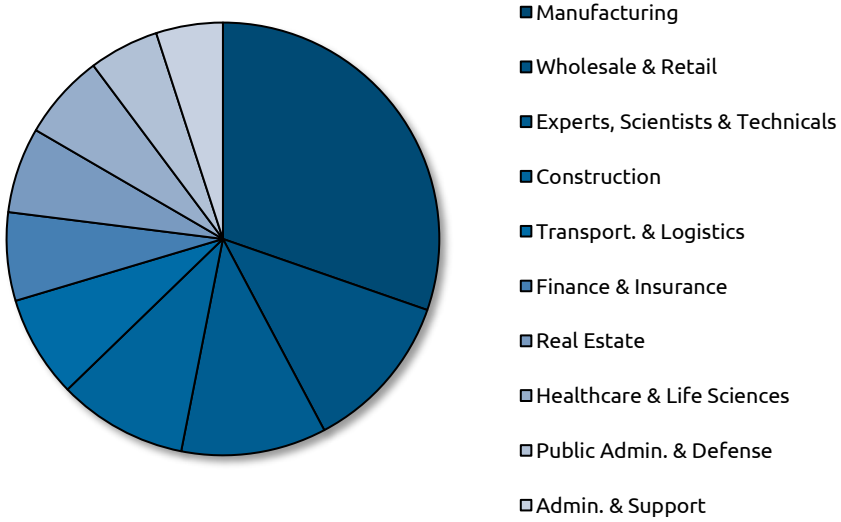
Top 10 sectors accounting for most of the employment

Belgium accounts for 2% of total EU employment (workers, employees, and self-employed) with an average level at 64.7%, corresponding to the **bottom median of all Member States.** The border countries to Belgium have higher levels of employment, notably the Netherlands and Germany with rates between 75 and 80%. Total employment in Belgium amounts to 4.8 million persons. This value is largely driven by the healthcare sector, manufacturing, and wholesale & retail. The aggregation of public services, i.e., defense, public security, public administration, healthcare and culture represents more than 35% of total employment.

However, both in terms of GDP and GDP per capita, Belgium is above the EU27 average and accounts for 3% of it overall. **The gross output is rather supported by the industrial and service sectors than by public services** - notably, a quarter of all output is generated by manufacturing, followed by wholesale & retail and EST* activities.

** EST: Experts, Scientists, Technicals*

Share of Sectors in Total Gross Output in Belgium (%)**



***Top 10 sectors accounting for most of the gross output*

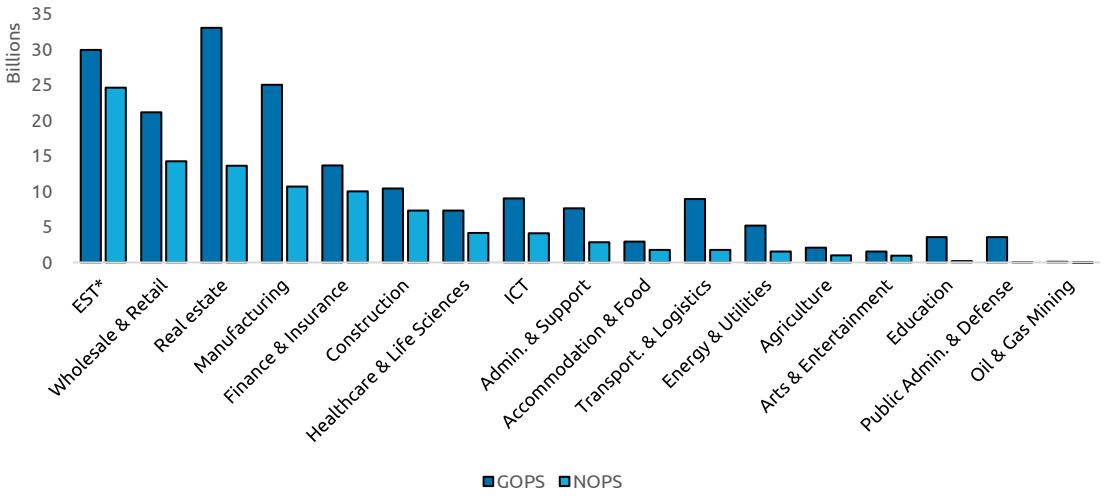
Source: OECD

ICT SPENDING STRUGGLES TO REACH 4% FOR THE PUBLIC SECTOR WHILE IT CLIMBS TO OVER 12% FOR MANUFACTURING

Beyond the main economic metrics, what are the leading industries?

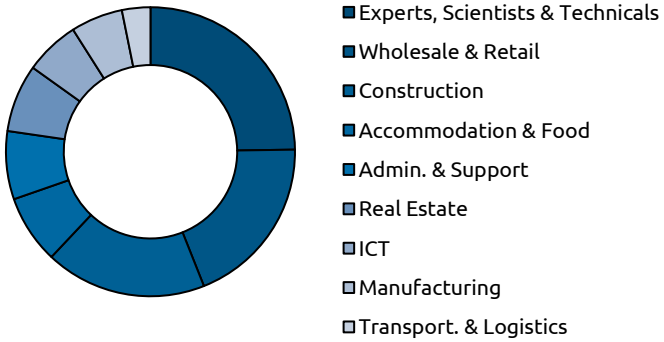
Accordingly, **the prevailing sectors in Belgium's production also exhibit the highest activity surpluses** – notably EST* activities, wholesale & retail, and manufacturing. While the real estate sector appears to be profitable in terms of capital income (GOPS), the inclusion of other factors of production, such as land and unpaid labor, have a considerable (negative) impact on its yield (NOPS).

Gross and Net Operating Surplus by Sector in Belgium (GOPS & NOPS) (EUR)



** EST: Experts, Scientists & Technicals*
Source: OECD

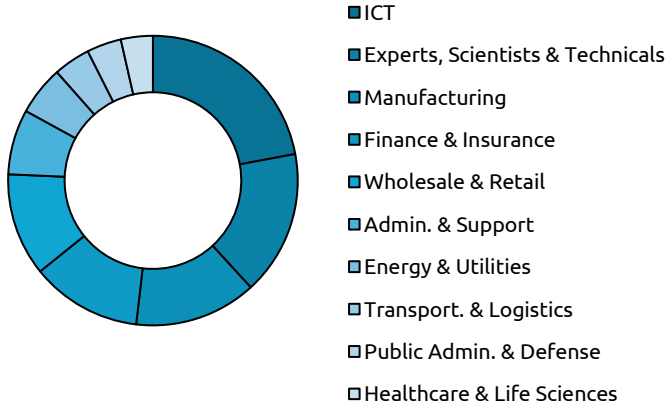
Number of Enterprises by Sector in Belgium



The preponderance of the EST* sector in the Belgian economy is maintained and amounts to barely less than a quarter of the number of companies, followed by wholesale & retail.

The available data do not offer figures for public order activities, due to a different status of sole enterprise.

Share of Sectors in Gross Fixed Capital Formation in ICT in Belgium (%)**



Excluding ICT activities, which – as foreseeable – generate the highest level of investment in ICT, EST* activities and manufacturing are the second and third largest investors annually, followed by financial activities. Public services (admin. & defense) provide less than 4% of these investments.

***Top 10 sectors accounting for most of the gross fixed capital formation (investment)*

5G SCALING COULD INCREASE BELGIUM'S COMPETITIVENESS BY IMPROVING BIG DATA & AI OPERATIONALIZATION

Is there a room for 5G in Belgium?

Key Takeaway

Various technologies could be upgraded by the integration of 5G, and among these, IoT, Big Data and AI often feature prominently. On the one hand, Belgium is in a good standing compared with its European peers regarding AI and Big Data. Therefore, the **deployment of 5G would constitute a tremendous enhancement for the activities employing** it. On the other hand, if the scope of IoT is barely less pronounced in the country compared to the rest of the EU, **5G rollout could be a booster to its incorporation and, consequently, a competitiveness promoter on the global scene**.

In addition, the **manufacturing, transportation & logistics, wholesale & retail sectors as well as the EST activities emerge as the sectoral powerhouses** of Belgium with respect to various economic indicators. However, it remains to be determined whether their interest is just as strong when the deployment of 5G and the underlying potential subsidies are factored in.

Internet of Things (IoT)

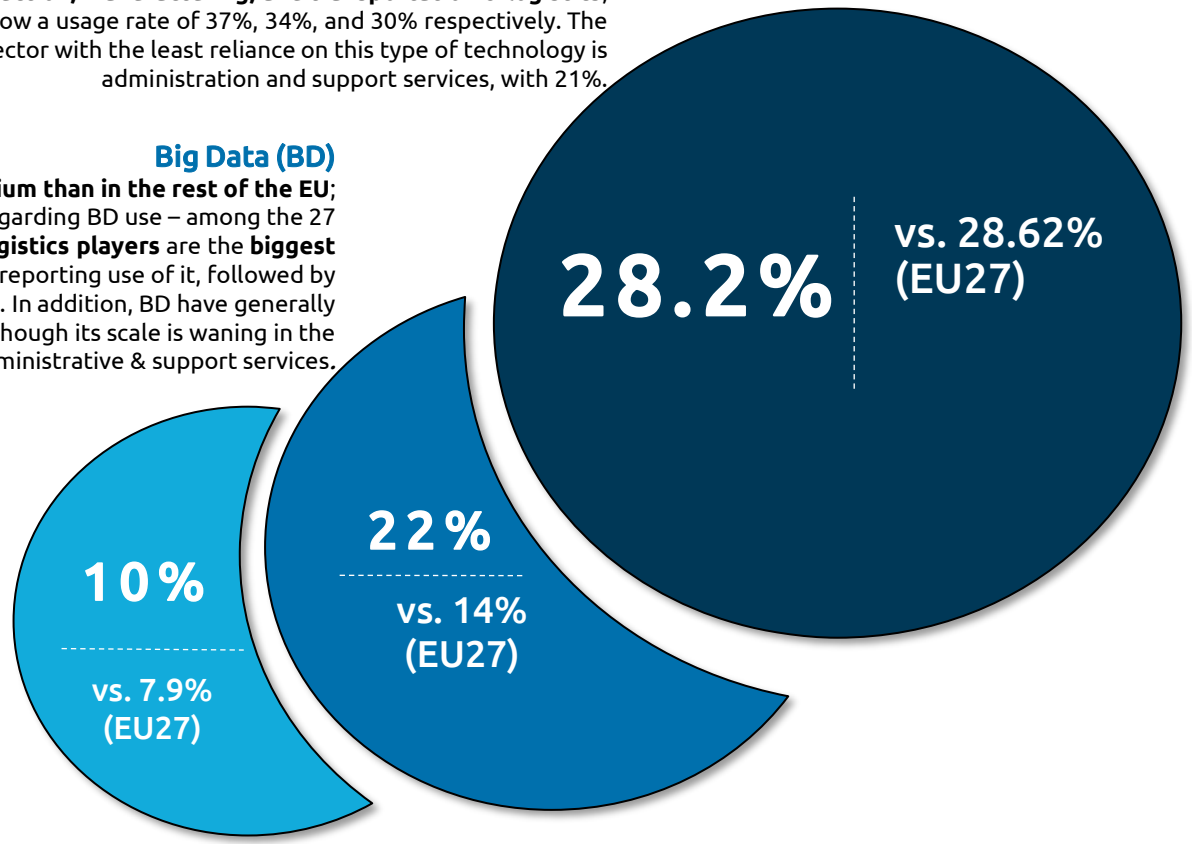
Belgium is **marginally below the European average for IoT usage** in business. The **industries driving** this use are **construction, manufacturing, and transportation & logistics**, which show a usage rate of 37%, 34%, and 30% respectively. The sector with the least reliance on this type of technology is administration and support services, with 21%.

Big Data (BD)

BD is much **more widespread in Belgium than in the rest of the EU**; the country ranks fourth – regarding BD use – among the 27 members. **Transportation & logistics players** are the **biggest adopters**, with 27% of businesses reporting use of it, followed by EST* activities and wholesale & retail. In addition, BD have generally gained ground over the years, although its scale is waning in the retail and administrative & support services.

Artificial Intelligence (AI)

The use of AI appears to be **more extensive in Belgium than in the rest of the Member States**. Although AI uptake still seems low compared to the other two technologies (IoT and BD), it has seen a big gain in popularity between 2020 and 2021, **mainly within ICT and EST* activities where AI implementation has more than doubled in just one year**. The levels in the latter sectors reach 34.8% and 20.2% respectively. Its utilization remains low in the transportation & logistics sector, where it stands at only 5.7%.



** EST: Experts, Scientists & Technicals*
Source: OECD

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