

The Digital Life initiative - Convergence for innovation



- | | |
|-------------|--|
| 10.15-10.45 | General information about the call
Researchers projects – «the boundary conditions» |
| 10.45-11.30 | «catalyzing» the process; 5 thematic areas presented |
| 11.30-12.00 | Innovation and industry |

Deadline April 15th

DL:Oslo

Steering group

- Svein Stølen, MN
- Hilde Nebb, MedFak
- Erlend Smeland, OUS
- Odd Stokke Gabrielsen, MLS
- John Torgils Vaage, HSØ

Project group

- Kjetill S. Jakobsen, MN
- Kjetil Tasken, MedFak (& MN)
- Arnaldo Frigessi, MedFak & OUS
- Eivind Hovig, OUS & MN
- Joakim Sundnes, SIMULA & UiO

Strategic initiative from BIOTEK2021



BIOTEK 2021

- Division for Innovation
- Address important societal challenges
- Contribute to biotechnological innovation
- Dialogue between various stakeholders (research is only one)
- Large projects (5) already initiated – marine biotech, industrial biotech, medical biotech

What is biotechnology?

- Begrepet **bioteknologi** forstås som anvendelse av naturvitenskap og teknologi på levende organismer og på deler, produkter og modeller av disse, slik at levende eller ikke-levende materialer endres for å frembringe kunnskap, varer og tjenester.
- Anvendelsesområdene er mange, og bioteknologi brukes innenfor sektorer som landbruk, havbruk, helse og industri.

Faglige prioriteringer

- **Marin bioteknologi** – videreutvikle et fundament
- **Biotek i landbruket** – videreutvikle fundament
- **Industriell bioteknologi** – bygge opp
- **Medisinsk bioteknologi** – videreutvikle og høste

Strategisk initiativ under BIOTEK2021

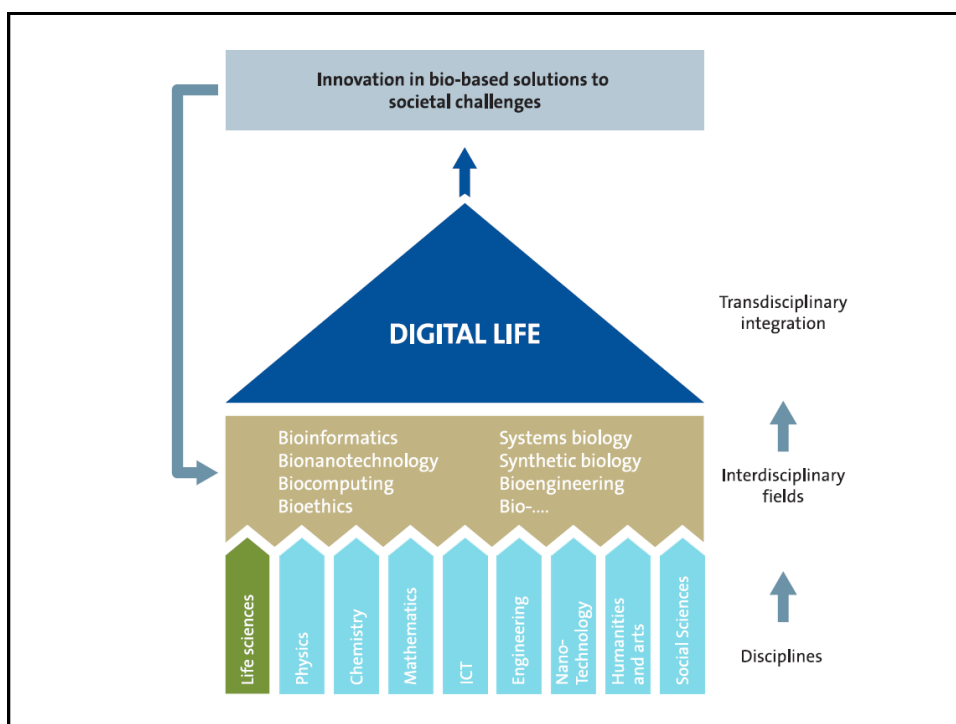


Aim of DL:

- create economic, societal and environmental **value** from **biotechnological** research and innovation, by encouraging **transdisciplinary** research.

How?

- research and innovation should take full advantage of the transformative technological and methodological opportunities offered by ongoing advances in **digitalisation** and the emerging potential for convergence across a range of **disciplines** .
- Integration of the life sciences with the **physical sciences**, **mathematical sciences**, **engineering sciences**, **social sciences** and beyond.



Todelt utlysning (over 5 år)

- Ledelse og nettverksprosjekt
– 30-50 mill.



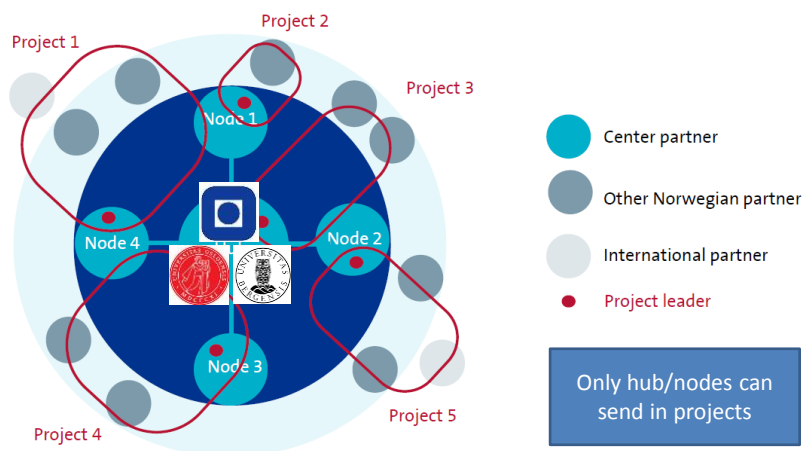
- HUB-node-structure = National centre
- Søker skal påta seg ansvaret for ledelses- og nettverksprosjektet. Ikke forskning.
- det kun skal etableres ett senter.

- Forskerprosjekter
– 200 mill.
– 10-40 mill. pr prosjekt

- Research
- Peer review prosess
- Innovasjon
- Not «business as usual»

Det forutsettes at de viktigste nasjonale aktørene innenfor Digitalliv skal delta i senteret.

Figure 4: Illustration of a model for the centre for Digital Life



NODER i nettverket

- = Institusjoner med konkrete forpliktelser i en eller flere arbeidspakker. Det forventes egenfinansiering og sterk strategisk forankring fra alle nav og node-kandidater.

Bioteknologi for verdiskaping (BIOTEK2021)

Etablering av "Nasjonalt senter for digitalt liv"

Det lyses ut inntil 250 millioner kroner til etablering av ett Nasjonalt senter for digitalt liv med oppstart i 2015. Senteret skal etableres som en del av en strategisk satsing innenfor BIOTEK2021.



Det forutsettes at følgende oppgaver inngår i ledelses- og nettverksprosjektet og er godt beskrevet i søknaden

- Styring og ledelse av senteret
- Datahåndtering, standardisering og metodologisk harmonisering
- Kurs og opplæring
- Utvikling av transdisiplinære arbeidsformer
- Internasjonalt samarbeid
- Ansvarlig forskning og innovasjon (RRI), kommunikasjon og samfunnsdialog
- Bedriftsinvolvering og teknologioverføring
- Andre fellesoppgaver som søker mener er viktige for å realisere senterets hensikt.



Figure 3. Illustration of the seven strategic elements part of the Digital Life initiative



Work packages (30-50 mill.)

DL-lighthouse

Ledelse, organisering, visjon, realisere ambisjoner og mål, konvergens, internasjonalisering, kobling mot forskerprosjektene

DL Future

mekanismer for å initiere nye fagområder, identifisere nye trender, konvergens

DL Talent

Forskerskole, sommerskole, nye kurs, transdisiplinært, talentutvikling, internasjonalisering

DL Data and methodology

Bioinformatikk, biostatistikk, modellering, **big data**, datagenerering, **datalagring og deling**, **sensitive data - TSD**, generiske kjernefasiliteter, standarder

DL Society

RRI (eventuell egen WP), kommunikasjon og samfunnsdialog, + mer

DL Growth

TTO, Innovasjon, ..., bedriftsinvolvering og teknologioverføring, Horisont 2020

Proessen videre

- De tre institusjonene etablerer en skrivegruppe (6 medlemmer) og styringsgruppe (3 medlemmer) for nettverksøknad (medio desember).
- Frist for institusjoner for å melde fra om ønske om ansvar og konkret rolle som node (9. januar)
- Styringsgruppe møte (medio januar)
- Skrivegruppe fremmer en skisse med nav-node struktur og innhold i arbeidspakkene (30 januar)
- Forslaget behandles av styringsgruppe (primo februar)
- Dialogmøte med nodene (medio februar)
- **Evaluering av søknaden med internasjonale eksperter (primo mars) og i regi av BIOTEK2021**
- Styringsgruppe godkjenner søknad før innsendelse (før påske)
- Søknaden sendes inn 14. April

Styringsstruktur

Senterledelse

NTNU

Styret

3 medlemmer (NTNU, UiO, UiB), styreleder (UiO)

2 medlemmer andre institusjoner

2 medlemmer fra industri, næringsliv

Ledergruppe

Senterleder (NTNU)

WP ledere

Prosjektledere (FPs)

Scientific advisory board

4 medlemmer

In parallell..

- Research projects



Three central questions:

- Digital life?
- National coordination?
- Div. for innovation in NFR?

prosess ..

Todelt utlysning (over 5 år)

- Ledelse og nettverksprosjekt
– 30-50 mill.



- nav-node-struktur = Nasjonalt senter
- Søker skal påta seg ansvaret for ledelses- og nettverksprosjektet.
- miljøene går sammen for å etablere gode samarbeidskonstellasjoner og relevant oppgavedeling, da det kun skal etableres ett senter.

- Forskerprosjekter
– 200 mill.
– 10-40 mill. pr prosjekt

- Peer review prosess
- Innovasjon
- Ikke «business as usual»

Defining Digital Life

- A wide array of interpretations
- Promote collaboration across disciplines: transdisciplinary
- Translating complex biological data into a systems biology context (use of informatics, statistics, modelling etc.)
- Biotechnological innovation
- BIOTEK2021: a continuation of FUGE

National coordination – research projects

- Consortium of collaborators/partners nationally (example UiO/OUS, UiB, NTNU, NMBU)
- How many partners?
- Industry a plus – but not a demand
- Innovation a key focus
- The national project must be anchored in the hub or nodes

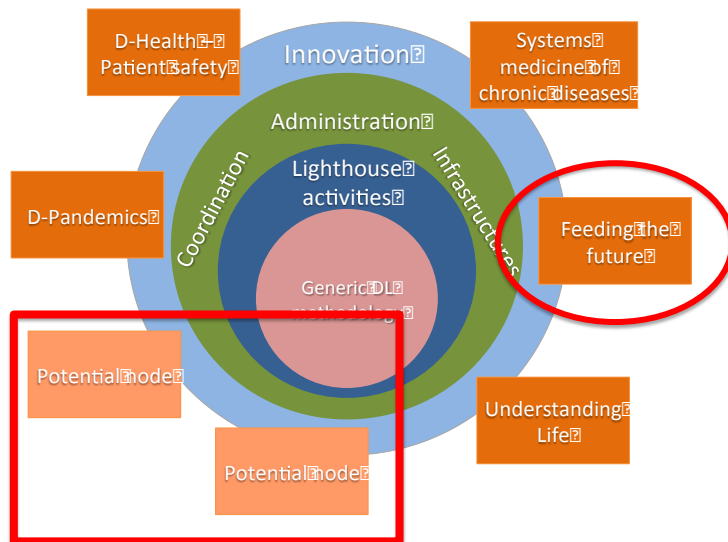
We are asked to prioritize!



- **Three issues:**
- Catalyse the process: Present some themes where we are strong and could take the lead
- Internal QA – process to be defined
 - Presentations with feedback early february
 - www.mn.uio.no/DL
 - Please remember: about 10-15 projects will get funding ..
- UiO expects to be able to contribute with resources to applications sent from UiO (should not give inbalance UiO:OUS – need projects from both)
 - PhD-positions

5 topics from the skisse-application (with coordinator/enabler)

- Feeding the future
 - Systems medicine
 - d-Health
 - d-Pandemics
 - Understanding life
- Kjetill S Jakobsen
 - Kjetil Tasken
 - Arnaldo Frigessi
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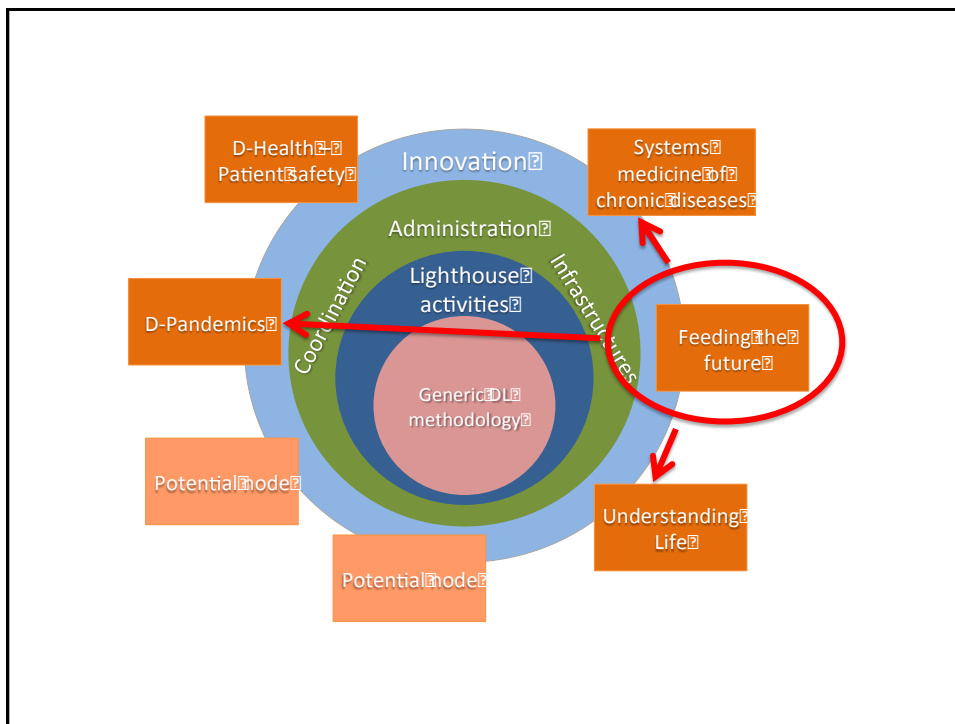
Feeding the future

Some topics:

- Use of “omics” data from bio-production systems translated into a functional understanding (systems biology)
- Marine, aquaculture, agricultural systems
- Model organisms needed (plants, fish, animals)
- Nutritional sciences – feed, food, health
- Disease resistance in production animals
- Food and environment: climate changes, sustainable ecosystems (management), fisheries
- Bioconversion: new catalytic methods combined with systems biol. and synthetic biol for food and feed

Feeding the future

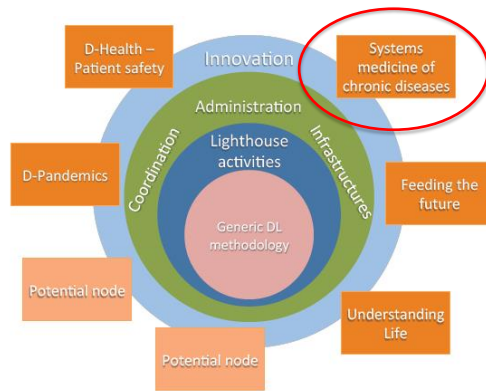
- Considerations:
 - ✓ Ongoing in BIOTEK2021: Aqua Genome Project, Salmosterile, Salmat – may provide platforms (+ national infrastructures: NorMic, NSC, ELIXIR, NorStruct etc)
 - ✓ DL national partners: NMBU, UIB, NTNU, UiT, HI, Nofima, VI
 - ✓ Trans-disciplinarity: also across themes (and institutions)
 - ✓ RRI
 - ✓ Node/lead function NMBU – others?
- Putative projects:
 - ✓ Plant and animal biology: optimizing breeds (genotypes) for a changing climate
 - ✓ Fisheries: systems biology for sustainable harvesting
 - ✓ Aquaculture: growth/maturation, disease resistance, feed/nutritional value, new species
 - ✓ The digital salmon



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DL: Systems medicine of chronic diseases



Personalized medicine

- Tailoring healthcare solutions to the individual patient – optimising drug efficacy
- Patient benefit: delivering ‘the right treatment to the right patient at the right time – or not treating
- More value from healthcare spending
- Aligned with European and national health

Personalized Medicine / Stratified Medicine / Tailored Therapy / Precision Medicine

- Many drugs are not effective in large patient populations, especially for chronic conditions like cancer, cardiovascular, psychiatric and inflammatory diseases.
- Capitalize on population-based registries and individual data to reach a systems understanding of health and disease:
 - **predictive** medicine (use of individual genetic information, biomarkers, etc, to identify the molecular mechanism of disease in the individual patient and do personalised diagnosis)
 - **preventive** medicine (specific individual measures to counteract molecular disease susceptibility)
 - **personalized** medicine (use of individual genetic information, drug responses ao, to tailor and optimise therapies)
- **Methods:** prepare therapy-related data at molecular and clinical levels, data integration, statistical variable selection, stochastic models, causal inference, genetic and environmental models, simulations and perturbations, prediction with uncertainty, n-of-one. **Also:** health economy, ethical and legal aspects,

Systems medicine of chronic diseases

– “imaginary” example projects

- Personalized medicine in cancer, modelling across diseases, pleiotropy and tumor heterogeneity, pan cancer models, signal sharing across pathways, cancer drug sensitivity screening, patient derived xenografting, n-of-one clinical trials. Biomarkers and companion diagnostics. Integration of heterogeneous data.
- Modelling of immune cell signals and immune cell population composition. Autoimmune diseases and/or cancer immune biology and tumor immune escape. Individualized immunotherapy
- Systems medicine of disease “X”. Sequence data, personal “omics” profiles, data integration, mathematical models, network methods, noise filtering, genotype-phenotype coupling / predictability of mutation impact. Integration of heterogeneous data.

Many potential projects in this area

- OUS/ UiO many strong areas and initiatives
- Other university hospitals and universities
- Registries and biobanks
- Industry and stakeholders

How to meet call specifics: incl. computational and modelling aspects, testing and perturbations, reiterative loops and translating to application (patients)

Modules, how to integrate, how to go beyond comfort zone and “business as usual” projects to deliver something ground-breaking and new.

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d-Health – Patient safety

- 20-25% of health care is not needed or potentially harmful. Need for improved **safety management in healthcare**.
- Very **much data** can be exploited to predict and control risk in healthcare: electronic health records, patient registries, biobanks, health surveys. But also sensors on patients and instruments. And coupling of all this data.
 - Early **detection of anomalies**, prediction of changes in risk.
 - **Remote care**, especially in the elderly, using mobile devices. Prevention, at distance consultation, continual monitoring for early signs of disease, self-help.
 - **Sensitive genome data** – also a patient safety issue
- **Methods**: clinical medicine, genomics, sensor technology, data mining, use of registries, mobile technology, “Big Data” methods, computer science, biostatistics and digital epidemiology.

d-Health – Patient safety: examples

- Chronic diseases like diabetes and schizophrenia require continuous treatment. By **linking together** traces of the personal behaviour (movement, activity, drug use), patient exposure (environment, weather), individual clinical information and genetic make-up, devise instruments to determine optimal therapy, doses, behaviour etc., dynamically in real time.
- Predict and control risk in healthcare organisations, in the transient phase, while the patients' conditions and/or the healthcare organisation change. The **automatic monitoring** of electronic journals, sensors on patients and on instruments can be exploited for early detection of anomalies and for prediction of changes in risk.

5 topics from the skisse-application (with coordinator/enabler)

- | | |
|----------------------|---------------------------|
| • Feeding the future | • Kjetill S Jakobsen |
| • Systems medicine | • Kjetil Tasken |
| • d-Health | • Arnaldo Frigessi |
| • d-Pandemics | • Arnaldo Frigessi |
| • Understanding life | • Eivind Hovig |

d-Pandemics

- Infectious diseases are a leading cause of death and life-threatening illnesses. The vast diversity of **microbes** and their ability to **evolve** and adjust to different situations and interventions, including drugs, is a serious threat to public health.
- Emerging threats, which can turn to devastating **pandemics**.
- Improve our ability to **prevent, detect, treat, manage** infectious diseases.
- Exploit technological advances (including genome-based diagnostics and monitoring), social network data (physical and internet based), to allow **inference of transmission** pathways and contacting networks.
- Veterinary infectious diseases: salmon, cattle, etc
- **Methods:** mathematical and statistical models, networks, computer science, epidemiology, clinical sciences, genomics.

d-Pandemics

- **Mobile communication data** used to study human contacts to predict the spatiotemporal spread of infectious diseases. Mathematical and statistical models (contact, network or other transmission models) allow simulation of disease spreading, assessment of the population ecology and genomics of microbes/viruses, testing of vaccination strategies and social interventions (like closing schools), in order to strengthen the preparedness to pandemics.

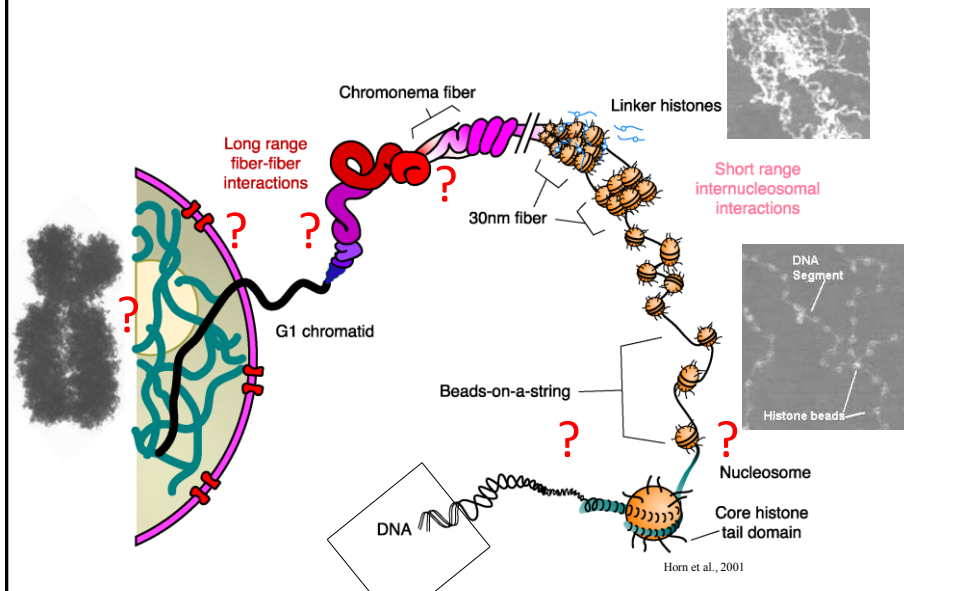
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Understanding life

- managing the breadth and wealth of existing information in complex life systems
- data reduction to home in on the critical aspects
- development of appropriate mathematical models
- at a wide range of space and time scales
- dynamic properties
- developing *predictive* virtual life science systems
- to capture the core elements in normal life functions
- from macroscale models via mesoscale models to first-principle molecular and atomistic models
- integrative biology across species and disciplines to a next level
- peta-scale computing
- interlinking generic digital aspects and biological processes in projects

Modeling nuclear DNA (example)



Possible components

- Atomistic models
- DNA polymer models at many scales
- DNA chromatin models
- DNA/protein interaction models
- Nuclear organization models
- Single cell dynamics
- Atoms
- Chromatin
- Higher order structures (fiber models and higher)
- Tissue organization
- DNA adducts
- DNA repair
- Mutation spectra
- Model systems
 - C elegans
 - Arabidopsis thaliana...

Why?

- Builds on existing strengths
- Ambitious
- Crosses methodological boundaries
- Cross-disciplinary
- Will benefit from chemistry, physics, statistical and mathematical approaches
- Has broad general application potential in health and disease

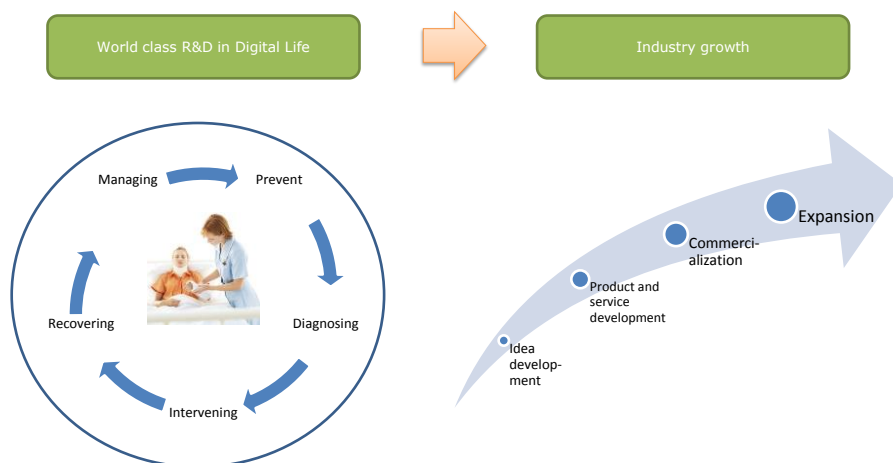
Næringslivsvekselvirkning

- The aim of this effort is to create economical, societal and environmental value for Norway, in part by helping existing bioindustries to gain further competitive advantages and by providing incentives for the emergence of new innovative companies
- Biotechnological innovation results from the complex co-production of technological advances, policies and societal values. Thus, the societal context represents a pivotal dimension in the DL-initiative

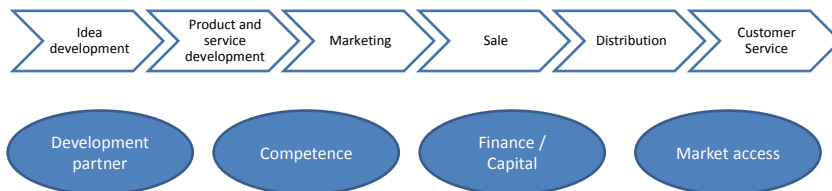
WP 6 – DL Innovation and growth

- Aim: Build in and secure the innovative perspectives and capacity in the research projects, and foster idea creation, innovation, commercialization and industry growth based on the results from the research projects
- How: Establish a «virtual network» of TTOs, incubators and clusters with competence and resources in the focus areas of Digital life. Draw on the network when establishing consortiums according to WP 4 – and in the idea creation, innovation, commercialization and industry growth-processes

Aim: Stimulate idea-creation, innovation, commercialization and industry growth within DigitalLife



Building and take in use existing methodology, infrastructure and network to help the projects find the right collaboration partners with the aim of developing products and solutions for the global market



inven2
OSLO TECH TRANSFER

SINVENT

HEIDNER

Norwegian Centre of Expertise
NCE Systems Engineering
Kongsberg

**OSLO
MED
TECH**

NTNU
Technology Transfer as



**OSLO CANCER
CLUSTER**



NCE
INTEGRATED CENTRES OF EXPERTISE
Smart Energy Markets

Center for Connected Care

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Next step WP6

- Invitation to take part in WP6 – before Christmas
- Final response by January 5th 2015
- Draft “proposal” by January 7th / meeting to discuss
- Send in “proposal” January 9th
- Oslo Medtech facilitate the process