

Preliminary Analyses RRI Tool Kit

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Intro

This is a short preliminary analysis of the contents included in the sample of projects indexed by RRI Tool Kit. By employing web scraping techniques, we were able to retrieve a total of 1,414 documents, along with a brief document description, their titles, and the discipline they belong to. Preliminary inspections to the database revealed that each document belonged to at least one of the following disciplines, but most documents show multidisciplinary categorizations. This multidisciplinaryity led us to map the information of each document and its disciplinary categorization by following network foundations.

```
setwd("~/Bilder/Documents/Paper0toFelipe/")
library(readxl)
LT <- read_excel("RawDataRRI.xlsx", sheet = "Raw LowerTags")
library(tidyr)
disciplines <- LT[1:47]
Disciplines <- disciplines %>%
  pivot_longer(!c(ID, Cases_Title, Cases_LowerTags),
               names_to = "Discipline", values_to = "sum")
rm(disciplines)
unique(Disciplines$Discipline)
```

```
## [1] "agribiotechnology"
## [2] "agriculture"
## [3] "ai ethics"
## [4] "artificial intelligence"
## [5] "Business & Industry"
## [6] "Civil Society Organizations"
## [7] "climate action"
## [8] "climate adaptation strategies"
## [9] "climate crisis"
## [10] "Climate, environment, and resources"
## [11] "digital technologies"
## [12] "Education Community"
## [13] "emerging technologies"
## [14] "Energy"
## [15] "energy transition"
## [16] "Ethics"
## [17] "ethics of ai"
## [18] "food"
## [19] "Food, agriculture, forestry, water and bio-economy"
## [20] "funding"
## [21] "future visions"
## [22] "Governance"
## [23] "h2020"
## [24] "health care"
```

```
## [25] "health technology"
## [26] "Health, demography & wellbeing"
## [27] "Inclusive, innovative, and reflective societies"
## [28] "mobility"
## [29] "patient engagement"
## [30] "plant biology"
## [31] "policy design"
## [32] "Policy Makers"
## [33] "Public Engagement"
## [34] "public trust"
## [35] "renewable energy"
## [36] "Research Community"
## [37] "responsible technology"
## [38] "robotics"
## [39] "rural environment"
## [40] "Science Education"
## [41] "Security"
## [42] "smart farming"
## [43] "vaccine hesitancy"
## [44] "vaccines"
```

We parsed the raw database as network data by using the unique numeric ID that identifies each document and the disciplines associated with each ID. For example, the following documents:

- Document 15: “Responsible Research and Innovation (RRI) in Plant Sciences”
- Document 582: “Ethical Tensions from New Technology. The Case of Agricultural Biotechnology”, and
- Document 1379: “Moving Forward Responsibly: From Agribiotechnology to Agrinanotechnology in India”

were all classified into the category of Agrobiotechnology. The network mapping procedure allowed us to understand what other disciplines proved to be relevant for these three documents beyond Agrobiotechnology. This analysis allowed us to provide a set of quantitative metrics that capture the interdisciplinarity of each document/discipline.

Token Example

For the sake of illustrative purposes, we turn the attention to a pairwise comparison between Agrobiotechnology and Civil Society and Organizations. This comparison initializes by filtering the records that belong to these disciplines

```
library(dplyr)

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##   filter, lag

## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union

Agrobiotechnology <- filter(LT, LT$agrobiotechnology == 1)
Agrobiotechnology <- Agrobiotechnology %>% pivot_longer(
  !c(ID, Cases_Title, Cases_LowerTags),
```

```

    names_to = "Discipline", values_to = "sum")
Agrobiotechnology[2:3] <- NULL
Agrobiotechnology <- filter(Agrobiotechnology, sum == 1)
Agrobiotechnology[3] <- NULL

CS <- filter(LT, LT$`Civil Society Organizations` == 1)
CS <- CS %>% pivot_longer(
  !c(ID, Cases_Title, Cases_LowerTags),
  names_to = "Discipline", values_to = "sum")
CS[2:3] <- NULL
CS <- filter(CS, sum == 1)
CS[3] <- NULL

```

After applying these filters, we parsed this data as network data as follows:

```

library(network)

## network: Classes for Relational Data
## Version 1.16.1 created on 2020-10-06.
## copyright (c) 2005, Carter T. Butts, University of California-Irvine
##           Mark S. Handcock, University of California -- Los Angeles
##           David R. Hunter, Penn State University
##           Martina Morris, University of Washington
##           Skye Bender-deMoll, University of Washington
## For citation information, type citation("network").
## Type help("network-package") to get started.

net_agro <- network(Agrobiotechnology, matrix.type = "edgelist", directed = FALSE, bipartite = FALSE)
net_agro

## Network attributes:
##   vertices = 20
##   directed = FALSE
##   hyper = FALSE
##   loops = FALSE
##   multiple = FALSE
##   bipartite = FALSE
##   total edges= 30
##     missing edges= 0
##     non-missing edges= 30
##
## Vertex attribute names:
##   vertex.names
##
## No edge attributes

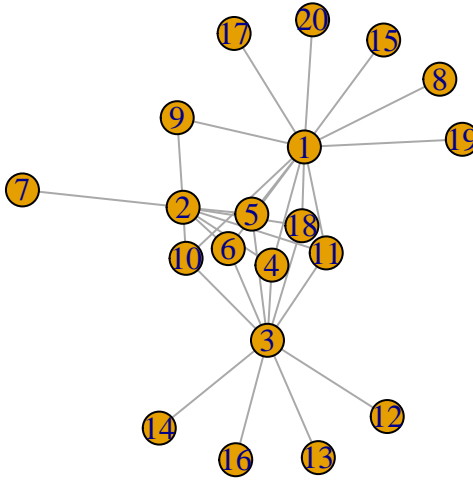
```

The network of Agrobiotechnology revealed a total of 20 vertices, and 30 edges that connect these vertices, a visual representation of this network is depicted as follows:

```

library(intergraph)
pave <- asIgraph(net_agro)
plot(pave, mode="fruchtermanreingold", vertex.cex=0.1)

```



In contrast, the network for the discipline of Civil Society and Organizations revealed a more complex structure, with a total of 792 vertices and 5,993 edges the connect these vertices.

```
net_CS <- network(CS, matrix.type = "edgelist", directed = FALSE, bipartite = FALSE)
net_CS
```

```
## Network attributes:
##   vertices = 792
##   directed = FALSE
##   hyper = FALSE
##   loops = FALSE
##   multiple = FALSE
##   bipartite = FALSE
##   total edges= 5993
##     missing edges= 0
##     non-missing edges= 5993
##
## Vertex attribute names:
##   vertex.names
##
## Edge attribute names not shown
```

Comparing all disciplines and documents from a network perspective aims to illustrate the multiple ways all these research projects from RRI Tool Kit connect among them, which helps identify where priorities are as a function of most needed goals in a globalized environment.