Influencing Factors on Internal Audit Maturity Using PLS-PM

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System Information

```r
#install.packages("sessioninfo")
sessioninfo::session_info()
```

```
## ─ Session info ───────────────────────────────────────────────────────────────
##  setting  value
##  version  R version 4.3.2 (2023-10-31 ucrt)
##  os       Windows 11 x64 (build 22621)
##  system   x86_64, mingw32
##  ui       RTerm
##  language (EN)
##  collate  Portuguese_Brazil.utf8
##  ctype    Portuguese_Brazil.utf8
##  tz       America/Sao_Paulo
##  date     2024-01-18
##  pandoc   2.12 @ C:/Users/RESEARCH/ANACON~1/envs/rstudio/Scripts/ (via rmarkdown)
##
## ─ Packages ───────────────────────────────────────────────────────────────────
##  package     * version date (UTC) lib source
##  bslib         0.6.1   2023-11-28 [1] CRAN (R 4.3.2)
##  cachem        1.0.8   2023-05-01 [1] CRAN (R 4.3.2)
##  cli           3.6.2   2023-12-11 [1] CRAN (R 4.3.2)
##  digest        0.6.34  2024-01-11 [1] CRAN (R 4.3.2)
##  evaluate      0.23    2023-11-01 [1] CRAN (R 4.3.2)
##  fastmap       1.1.1   2023-02-24 [1] CRAN (R 4.3.2)
##  htmltools     0.5.7   2023-11-03 [1] CRAN (R 4.3.2)
##  jquerylib     0.1.4   2021-04-26 [1] CRAN (R 4.3.2)
##  jsonlite      1.8.8   2023-12-04 [1] CRAN (R 4.3.2)
##  knitr         1.45    2023-10-30 [1] CRAN (R 4.3.2)
##  lifecycle     1.0.4   2023-11-07 [1] CRAN (R 4.3.2)
##  R6            2.5.1   2021-08-19 [1] CRAN (R 4.3.2)
##  rlang         1.1.3   2024-01-10 [1] CRAN (R 4.3.2)
##  rmarkdown     2.25    2023-09-18 [1] CRAN (R 4.3.2)
##  rstudioapi    0.15.0  2023-07-07 [1] CRAN (R 4.3.2)
##  sass          0.4.8   2023-12-06 [1] CRAN (R 4.3.2)
##  sessioninfo   1.2.2   2021-12-06 [1] CRAN (R 4.3.2)
##  xfun          0.41    2023-11-01 [1] CRAN (R 4.3.2)
##  yaml          2.3.8   2023-12-11 [1] CRAN (R 4.3.2)
##
##  [1] C:/Users/RESEARCH/AppData/Local/Programs/R/R-4.3.2/library
##
## ──────────────────────────────────────────────────────────────────────────────
```

Library

```r
#install.packages("formattable", dependencies=TRUE)
```

```r
#install.packages("rlist", dependencies=TRUE)
```

```r
library(plspm)
library(readxl)
require(pwr)
```

```
## Carregando pacotes exigidos: pwr
```

```r
require(formattable)
```

```
## Carregando pacotes exigidos: formattable
```

```
##
## Attaching package: 'formattable'
```

```
## The following object is masked from 'package:plspm':
##
##     normalize
```

```r
library(car)
```

```
## Carregando pacotes exigidos: carData
```

```r
library(effectsize)
```

Size of Sample

```r
sample<-pwr.f2.test(u=7, v=NULL, f2=0.15, sig.level=0.05, power=0.8)
sample[["v"]]+sample[["u"]]+1
```

```
## [1] 102.9149
```

```r
rm("sample")
```

Variables Meaning

IAM: Internal Audit Maturity

QUAL: Qualification

STRATOR: Strategic Orientation

ASSES: Assessment

EVALRESP: Evaluate Responsibility

DRRELAREA: Direct Responsibility for Related Areas

INVAREA: Involvement Areas

PARTN: Partnership

TYPINF: Types of Information

Reading DataFrame and Transformation

```r
table <-read_excel('Base tratada.xlsx', sheet = 'Base tratada', range = 'A1:AX1999')
table[is.na(table)] <- 0
```

```r
colnames(table)
```

```
##  [1] "AEXP"      "CIA"       "FPESQ"     "HTREIN"    "CODETIC"   "CARTA"
##  [7] "MANOPER"   "EAI"       "ICP"       "MISSAO"    "MAI"       "FAVEXT"
## [13] "FAVINT"    "FCOMRES"   "FCTERC"    "FRACONT"   "FRAGOV"    "FRAGR"
## [19] "ASOOC"     "PREST"     "BENCH"     "REMERG"    "CINTER"    "CNEG"
## [25] "ECASO"     "MPRAT"     "PAUDIT"    "MODEL"     "GUIA"      "RFCOAUD"
## [31] "RDCONFG"   "RDGR"      "RDETIC"    "RDFRAUD"   "RDGOVRC"   "RDCREPFIN"
## [37] "ECONF"     "ERCUSTO"   "ECIBER"    "EGR"       "EREPFIN"   "EFIN"
## [43] "EFRAUD"    "EGOVCULT"  "ETI"       "ERTERC"    "EOPER"     "EAUDEXT"
## [49] "ESUST"     "TERC"
```

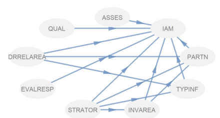
```r
colnames(table)[1] <- "QUAL1" #AEXP para QUAL1
colnames(table)[2] <- "QUAL2" #CIA para QUAL2
colnames(table)[3] <- "QUAL3" #FPESQ para QUAL3
colnames(table)[4] <- "QUAL4" #HTREIN para QUAL4
colnames(table)[5] <- "STRATOR1" #CODETIC para STRATOR1
colnames(table)[6] <- "STRATOR2" #CARTA para STRATOR2
colnames(table)[7] <- "STRATOR3" #MANOPER para STRATOR3
colnames(table)[8] <- "STRATOR4" #EAI para STRATOR4
colnames(table)[9] <- "STRATOR5" #ICP para STRATOR5
colnames(table)[10] <- "STRATOR6" #MISSAO para STRATOR6
colnames(table)[11] <- "IAM" #IAM
colnames(table)[12] <- "ASSES1" #FAVEXT para ASSES1
colnames(table)[13] <- "ASSES2" #FAVINT para ASSES2
colnames(table)[14] <- "ASSES3" #FCOMRES para ASSES3
colnames(table)[15] <- "PARTN1" #FCTERC para PARTN1
colnames(table)[16] <- "EVALRESP1" #EVALRESPCONT para EVALRESP1
colnames(table)[17] <- "EVALRESP2" #EVALRESPGOV para EVALRESP2
colnames(table)[18] <- "EVALRESP3" #EVALRESPGR para EVALRESP3
colnames(table)[19] <- "PARTN2" #ASTRATOROC para PARTN2
colnames(table)[20] <- "PARTN3" #PREST para PARTN3
colnames(table)[21] <- "TYPINF1" #BENCH para TYPINF1
colnames(table)[22] <- "TYPINF2" #REMERG para TYPINF2
colnames(table)[23] <- "TYPINF3" #CINTER para TYPINF3
colnames(table)[24] <- "TYPINF4" #CNEG para TYPINF4
colnames(table)[25] <- "TYPINF5" #ECASTRATOR para TYPINF5
colnames(table)[26] <- "TYPINF6" #MPRAT para TYPINF6
colnames(table)[27] <- "TYPINF7" #PAUDIT para TYPINF7
colnames(table)[28] <- "TYPINF8" #MODEL para TYPINF8
colnames(table)[29] <- "TYPINF9" #GUIA para TYPINF9
colnames(table)[30] <- "STRATOR7" #RFCOAUD para OE7
colnames(table)[31] <- "DRRELAREA1" #RDCONFG para DRRELAREA1
colnames(table)[32] <- "DRRELAREA2" #RDGR para DRRELAREA2
colnames(table)[33] <- "DRRELAREA3" #RDETIC para DRRELAREA3
colnames(table)[34] <- "DRRELAREA4" #RDEVALRESPUD para DRRELAREA4
colnames(table)[35] <- "DRRELAREA5" #RDGOVRC para DRRELAREA5
colnames(table)[36] <- "DRRELAREA6" #RDCREPFIN para DRRELAREA6
colnames(table)[37] <- "INVAREA1" #ECONF para INVAREA1
colnames(table)[38] <- "INVAREA2" #ERCUSTO para INVAREA2
colnames(table)[39] <- "INVAREA3" #ECIBER para INVAREA3
colnames(table)[40] <- "INVAREA4" #EGR para INVAREA4
colnames(table)[41] <- "INVAREA5" #EREPFIN para INVAREA5
colnames(table)[42] <- "INVAREA6" #EFIN para INVAREA6
colnames(table)[43] <- "INVAREA7" #EEVALRESPUD para INVAREA7
colnames(table)[44] <- "INVAREA8" #EGOVCULT para INVAREA8
colnames(table)[45] <- "INVAREA9" #ETI para INVAREA9
colnames(table)[46] <- "INVAREA10" #ERTERC para INVAREA10
colnames(table)[47] <- "INVAREA11" #EOPER para INVAREA11
colnames(table)[48] <- "INVAREA12" #EAUDEXT para INVAREA12
colnames(table)[49] <- "INVAREA13" #ESUST para INVAREA13
colnames(table)[50] <- "PARTN4" #TERC para PARTN4
colnames(table)
```

```
##  [1] "QUAL1"      "QUAL2"      "QUAL3"      "QUAL4"      "STRATOR1"
##  [6] "STRATOR2"   "STRATOR3"   "STRATOR4"   "STRATOR5"   "STRATOR6"
## [11] "IAM"        "ASSES1"     "ASSES2"     "ASSES3"     "PARTN1"
## [16] "EVALRESP1"  "EVALRESP2"  "EVALRESP3"  "PARTN2"     "PARTN3"
## [21] "TYPINF1"    "TYPINF2"    "TYPINF3"    "TYPINF4"    "TYPINF5"
## [26] "TYPINF6"    "TYPINF7"    "TYPINF8"    "TYPINF9"    "STRATOR7"
## [31] "DRRELAREA1" "DRRELAREA2" "DRRELAREA3" "DRRELAREA4" "DRRELAREA5"
## [36] "DRRELAREA6" "INVAREA1"   "INVAREA2"   "INVAREA3"   "INVAREA4"
## [41] "INVAREA5"   "INVAREA6"   "INVAREA7"   "INVAREA8"   "INVAREA9"
## [46] "INVAREA10"  "INVAREA11"  "INVAREA12"  "INVAREA13"  "PARTN4"
```

Triangular matrix

```r
path.matrix <- matrix(0, nrow = 9, ncol = 9)
path.matrix[9,]<-rep(1,9) # every variable explain IAM
path.matrix[9,9]<-0 # without feeedback
path.matrix[8,6]<-1 # effect from INVAREA to PARTN
path.matrix[8,3]<-1 # effect from DRRELAREA to PARTN
path.matrix[8,5]<-1 # effect from STRATOR to PARTN
path.matrix[7,5]<-1 # effect from STRATOR to TYPINF
path.matrix[6,5]<-1 # effect from STRATOR to INVAREA
path.matrix[7,3]<-1 # effect from DRRELAREA to TYPINF
colnames(path.matrix)=rownames(path.matrix)<-c("ASSES","QUAL","DRRELAREA", "EVALRESP", "STRATOR", "INVAREA", "TYPI
NF", "PARTN","IAM")
```

```r
innerplot(path.matrix)
```



Block Variable

Defining the block of variables. Each line is a latent variable

Each indicators present in line is the relection of the LV.

```r
block.indicators <- list(
    c('ASSES1','ASSES2', 'ASSES3'), #faq
    c('QUAL1','QUAL2','QUAL3','QUAL4'), #QUAL
    c('DRRELAREA1','DRRELAREA2','DRRELAREA3','DRRELAREA4','DRRELAREA5','DRRELAREA6'),
    c('EVALRESP1','EVALRESP2', 'EVALRESP3'),
    c('STRATOR1','STRATOR2','STRATOR3','STRATOR4','STRATOR5','STRATOR6','STRATOR7'),
    c('INVAREA1','INVAREA2','INVAREA3','INVAREA4','INVAREA5','INVAREA6','INVAREA7','INVAREA8','INVAREA9','INVAREA1
0','INVAREA11','INVAREA12','INVAREA13'),
    c('TYPINF1','TYPINF2','TYPINF3','TYPINF4','TYPINF5','TYPINF6','TYPINF7','TYPINF8','TYPINF9'),
   c("PARTN1","PARTN2","PARTN3","PARTN4"),
   c('IAM'))
```

Scale Definition

Definig the scale (what is numeric and what is nominal=non-metric)

```
scaled <- list(
    rep("NOM",3), #faq
    c("NUM", "NOM","NOM","NUM"), #QUAL
    rep("NOM",6), #rdac
    rep("NOM",3), #fra
    rep("NOM",7), #STRATOR
    rep("NOM",13), #ec
    rep("NOM",9), #bia
    c("NOM", "NOM","NOM","NUM"), #pt
    c("NUM") #mai
    )
```

Reflexive Mode

All Latent Variables are reflexive

```
modes <- rep("A",9)
```

External Model Validation

First running to measure indicators

```
model_pls1 = plspm(table,
                   path.matrix,
                   block.indicators,
                   modes = modes,
                   scaling = scaled,
                   scaled = TRUE,
                   scheme = "path",
                   tol = 1e-7, #tolerância
                   maxiter=300, #número de interações máximas
                   boot.val =TRUE, #com bootstrapping
                   br=100) #número de amostra bootstrapping
```

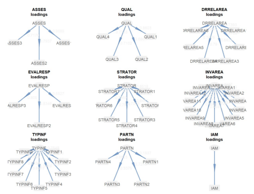
```
## Warning: Setting row names on a tibble is deprecated.
```

Alpha Cronbach, Rho, Eigenvalue

```
options(repr.plot.width = 1, repr.plot.height = 0.75, repr.plot.res = 100)
formattable(model_pls1$unidim , list(
   C.alpha = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color
= "green", font.weight = "bold"))),
   DG.rho = formatter("span", style = x ~ ifelse(x < 0.5, style(color = "red", font.weight = "bold"), style(color
= "green", font.weight = "bold"))),
   eig.1st=color_tile("white", "yellow"),
   eig.2nd=color_tile("white", "purple")
))
```

	Mode	MVs	C.alpha	DG.rho	eig.1st	eig.2nd
ASSES	A	3	0.7463813	0.85564981	1.993188	0.5923898
QUAL	A	4	0.7557806	0.84582067	2.318345	0.7143565
DRRELAREA	A	6	0.8021518	0.85924359	3.043606	0.8220197
EVALRESP	A	3	0.6039255	0.79126296	1.677185	0.7377764
STRATOR	A	7	0.8997010	0.92140957	4.392699	0.6712617
INVAREA	A	13	0.8713187	0.89423412	5.156630	1.0539624
TYPINF	A	9	0.9112693	0.92779984	5.320419	0.8108628
PARTN	A	4	0.1567167	0.01751683	1.262489	1.1879879
IAM	A	1	1.0000000	1.00000000	1.000000	0.0000000

```
plot(model_pls1, what="loadings", arr.width = 0.1)
```




```
options(repr.plot.width = 1, repr.plot.height = 0.75, repr.plot.res = 100)
formattable(model_pls1$outer_model, list(
    loading = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(colo
r = "green", font.weight = "bold"))),
   communality = formatter("span", style = x ~ ifelse(x < 0.5, style(color = "red", font.weight = "bold"), style(c
olor = "green", font.weight = "bold"))),
   redundancy=color_tile("white", "yellow")
))
```

name	block	weight	loading	communality	redundancy
ASSES1	ASSES	0.56934845	0.9084924	0.82535837	0.00000000
ASSES2	ASSES	0.33541023	0.7937113	0.62997759	0.00000000
ASSES3	ASSES	0.30159958	0.7179466	0.51544737	0.00000000
QUAL1	QUAL	0.40147330	0.8602531	0.74003544	0.00000000
QUAL2	QUAL	0.26194010	0.6864366	0.47119514	0.00000000
QUAL3	QUAL	0.29467413	0.7101656	0.50433512	0.00000000
QUAL4	QUAL	0.34297885	0.7742713	0.59949597	0.00000000
DRRELAREA1	DRRELAREA	0.22326949	0.7392682	0.54651742	0.00000000
DRRELAREA2	DRRELAREA	0.22820717	0.7219880	0.52126667	0.00000000
DRRELAREA3	DRRELAREA	0.23658608	0.6824689	0.46576378	0.00000000
DRRELAREA4	DRRELAREA	0.28993479	0.7900188	0.62412963	0.00000000
DRRELAREA5	DRRELAREA	0.22278888	0.7475733	0.55886578	0.00000000
DRRELAREA6	DRRELAREA	0.19953889	0.5668748	0.32134705	0.00000000
EVALRESP1	EVALRESP	0.23604765	0.5527463	0.30552847	0.00000000
EVALRESP2	EVALRESP	0.55143533	0.8346194	0.69658954	0.00000000
EVALRESP3	EVALRESP	0.50842656	0.8050069	0.64803618	0.00000000
STRATOR1	STRATOR	0.19424368	0.8518098	0.72557988	0.00000000
STRATOR2	STRATOR	0.22900262	0.8722600	0.76083756	0.00000000
STRATOR3	STRATOR	0.19968139	0.8491360	0.72103203	0.00000000
STRATOR4	STRATOR	0.14410503	0.7029008	0.49406959	0.00000000
STRATOR5	STRATOR	0.15774279	0.7511193	0.56418019	0.00000000
STRATOR6	STRATOR	0.17153582	0.7968780	0.63501448	0.00000000
STRATOR7	STRATOR	0.15567777	0.6986645	0.48813204	0.00000000
INVAREA1	INVAREA	0.16854396	0.7187450	0.51659431	0.27010341
INVAREA2	INVAREA	0.08356631	0.4978693	0.24787381	0.12960182
INVAREA3	INVAREA	0.13374281	0.6778578	0.45949126	0.24024685
INVAREA4	INVAREA	0.15376180	0.6991967	0.48887608	0.25561082
INVAREA5	INVAREA	0.09965844	0.5505226	0.30307516	0.15846407
INVAREA6	INVAREA	0.10062361	0.6353782	0.40370547	0.21107903
INVAREA7	INVAREA	0.15250288	0.6728581	0.45273803	0.23671590
INVAREA8	INVAREA	0.13311893	0.6582953	0.43335270	0.22658020
INVAREA9	INVAREA	0.12936865	0.6993204	0.48904907	0.25570127
INVAREA10	INVAREA	0.09172295	0.5935868	0.35234533	0.18422517
INVAREA11	INVAREA	0.11941694	0.6504924	0.42314039	0.22124065
INVAREA12	INVAREA	0.12442556	0.5445824	0.29656999	0.15506281
INVAREA13	INVAREA	0.07698566	0.5155287	0.26576988	0.13895885
TYPINF1	TYPINF	0.14664126	0.7648874	0.58505266	0.40939473
TYPINF2	TYPINF	0.17068802	0.8298251	0.68860971	0.48185951
TYPINF3	TYPINF	0.16097989	0.8341564	0.69581686	0.48690276
TYPINF4	TYPINF	0.15621486	0.7983066	0.63729339	0.44595055
TYPINF5	TYPINF	0.08386989	0.5449305	0.29694930	0.20779237
TYPINF6	TYPINF	0.16889903	0.8403378	0.70616754	0.49414572
TYPINF7	TYPINF	0.15123516	0.8135730	0.66190096	0.46316987
TYPINF8	TYPINF	0.13853863	0.7898996	0.62394132	0.43660735
TYPINF9	TYPINF	0.10362720	0.6474852	0.41923704	0.29336408
PARTN1	PARTN	0.10588553	0.1937467	0.03753777	0.01707702
PARTN2	PARTN	0.74594937	0.7246391	0.52510184	0.23888400
PARTN3	PARTN	0.42365197	0.3375107	0.11391344	0.05182252
PARTN4	PARTN	0.44688378	0.6622614	0.43859020	0.19952735
IAM	IAM	1.00000000	1.0000000	1.00000000	0.80815149

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following object is masked from 'package:car':
##
##     recode
```

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

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

Remove those below the metric 0.7 and 0.5

Removing all indicators below the reliability threshold

```
subsets.approved<-model_pls1$outer_model%>%
  filter(loading >=0.7 & communality >=0.5)
```

Plotting the remaining indicators

```
options(repr.plot.width = 1, repr.plot.height = 0.75, repr.plot.res = 100)
formattable(subsets.approved, list(
    loading = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(colo
r = "green", font.weight = "bold"))),
   communality = formatter("span", style = x ~ ifelse(x < 0.5, style(color = "red", font.weight = "bold"), style(c
olor = "green", font.weight = "bold"))),
   redundancy=color_tile("white", "yellow")
))
```

name	block	weight	loading	communality	redundancy
ASSES1	ASSES	0.5693484	0.9084924	0.8253584	0.0000000
ASSES2	ASSES	0.3354102	0.7937113	0.6299776	0.0000000
ASSES3	ASSES	0.3015996	0.7179466	0.5154474	0.0000000
QUAL1	QUAL	0.4014733	0.8602531	0.7400354	0.0000000
QUAL3	QUAL	0.2946741	0.7101656	0.5043351	0.0000000
QUAL4	QUAL	0.3429788	0.7742713	0.5994960	0.0000000
DRRELAREA1	DRRELAREA	0.2232695	0.7392682	0.5465174	0.0000000
DRRELAREA2	DRRELAREA	0.2282072	0.7219880	0.5212667	0.0000000
DRRELAREA4	DRRELAREA	0.2899348	0.7900188	0.6241296	0.0000000
DRRELAREA5	DRRELAREA	0.2227889	0.7475733	0.5588658	0.0000000
EVALRESP2	EVALRESP	0.5514353	0.8346194	0.6965895	0.0000000
EVALRESP3	EVALRESP	0.5084266	0.8050069	0.6480362	0.0000000
STRATOR1	STRATOR	0.1942437	0.8518098	0.7255799	0.0000000
STRATOR2	STRATOR	0.2290026	0.8722600	0.7608376	0.0000000
STRATOR3	STRATOR	0.1996814	0.8491360	0.7210320	0.0000000
STRATOR5	STRATOR	0.1577428	0.7511193	0.5641802	0.0000000
STRATOR6	STRATOR	0.1715358	0.7968780	0.6350145	0.0000000
INVAREA1	INVAREA	0.1685440	0.7187450	0.5165943	0.2701034
TYPINF1	TYPINF	0.1466413	0.7648874	0.5850527	0.4093947
TYPINF2	TYPINF	0.1706880	0.8298251	0.6886097	0.4818595
TYPINF3	TYPINF	0.1609799	0.8341564	0.6958169	0.4869028
TYPINF4	TYPINF	0.1562149	0.7983066	0.6372934	0.4459506
TYPINF6	TYPINF	0.1688990	0.8403378	0.7061675	0.4941457
TYPINF7	TYPINF	0.1512352	0.8135730	0.6619010	0.4631699
TYPINF8	TYPINF	0.1385386	0.7898996	0.6239413	0.4366073

name	block	weight	loading	communality	redundancy
PARTN2	PARTN	0.7459494	**0.7246391**	**0.5251015**	0.2388840
IAM	IAM	1.0000000	**1.0000000**	**1.0000000**	0.8681015

Creating the new block of variables containing reliables indicators

```
block.indicators.novo <- list(
    c('ASSES1','ASSES2', 'ASSES3'), #ASSES
    c('QUAL1','QUAL3','QUAL4'), #QUAL
    c('DRRELAREA1', 'DRRELAREA2','DRRELAREA4','DRRELAREA5'),
    c('EVALRESP2', 'EVALRESP3'),
    c('STRATOR1','STRATOR2','STRATOR3','STRATOR5','STRATOR6'),
    c('INVAREA1'),
    c('TYPINF1','TYPINF2','TYPINF3','TYPINF5','TYPINF6','TYPINF7','TYPINF8'),
    c('PARTN2'),
    c('IAM'))
### Escalando como numérico e nominal
scaled.novo <- list(
    rep("NOM",10), #ASSES
    c("NOM", "NOM","NOM"), #QUAL
    rep("NOM",4), #DRRELAREA
    rep("NOM",2), #EVALRESP
    rep("NOM",5), #STRATOR
    rep("NOM",1), #INVAREA
    rep("NOM",7), #TYPINF
    c("NOM"),#PARTN
    c("NOM") #IAM
    )

modes <- rep("A",9)
model.plot.treatment2 = plspm(table,
                  path.matrix,
                  block.indicators.novo,
                  modes = modes,
                  scaling = scaled.novo,
                  scaled = TRUE,
                  scheme = "path",
                  tol = 1e-7, #tolerância
                  maxit=100, #número de interações máximas
                  boot.val =TRUE, #com bootstrapping
                  br=100) #número de amostra bootstrapping
```

```
## Warning: Setting row names on a tibble is deprecated.
```

See again the LV Reliability

```
options(repr.plot.width = 1, repr.plot.height = 0.75, repr.plot.res = 100)
formattable(model_plot.treatment2$unidim , list(
    C.alpha = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color
= "green", font.weight = "bold")),
    DG.rho = formatter("span", style = x ~ ifelse(x < 0.5, style(color = "red", font.weight = "bold"), style(color
= "green", font.weight = "bold")),
    eig.1st=color_tile("white", "yellow"),
    eig.2nd=color_tile("white", "purple")
))
```

	Mode	MVs	C.alpha	DG.rho	eig.1st	eig.2nd
ASSES	A	3	**0.7463813**	**0.8556496**	1.993188	0.5923898
QUAL	A	3	**0.7311546**	**0.8481344**	1.952246	0.5834945
DRRELAREA	A	4	**0.7890320**	**0.8635029**	2.451396	0.5933478
EVALRESP	A	2	**0.5856609**	**0.8283841**	1.414698	0.5859119
STRATOR	A	5	**0.8828571**	**0.9214160**	3.539126	0.5100422
INVAREA	A	1	**1.0000000**	**1.0000000**	1.000000	0.0000000
TYPINF	A	7	**0.9164128**	**0.9332816**	4.667357	0.5769790
PARTN	A	1	**1.0000000**	**1.0000000**	1.000000	0.0000000
IAM	A	1	**1.0000000**	**1.0000000**	1.000000	0.0000000

```
options(repr.plot.width = 1, repr.plot.height = 0.75, repr.plot.res = 100)
formattable(model_plot.treatment2$outer_model, list(
    loading = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(colo
r = "green", font.weight = "bold"))),
    communality = formatter("span", style = x ~ ifelse(x < 0.5, style(color = "red", font.weight = "bold"), style(c
olor = "green", font.weight = "bold"))),
    redundancy=color_tile("white", "yellow")
))
```

name	block	weight	loading	communality	redundancy
ASSES1	ASSES	0.5693484	**0.9084924**	**0.8253384**	0.0000000
ASSES2	ASSES	0.3354102	**0.7937113**	**0.6299776**	0.0000000
ASSES3	ASSES	0.3015996	**0.7173466**	**0.5144474**	0.0000000
QUAL1	QUAL	0.4767963	**0.8570977**	**0.7346165**	0.0000000
QUAL3	QUAL	0.3490599	**0.7478610**	**0.5592961**	0.0000000
QUAL4	QUAL	0.4073274	**0.8092264**	**0.6548377**	0.0000000
DRRELAREA1	DRRELAREA	0.3051859	**0.7777597**	**0.6049101**	0.0000000
DRRELAREA2	DRRELAREA	0.2963412	**0.7552582**	**0.5704150**	0.0000000
DRRELAREA4	DRRELAREA	0.3839140	**0.7967093**	**0.6347456**	0.0000000
DRRELAREA5	DRRELAREA	0.2928219	**0.7955581**	**0.6329128**	0.0000000
EVALRESP2	EVALRESP	0.6185468	**0.8547055**	**0.7305215**	0.0000000
EVALRESP3	EVALRESP	0.5703056	**0.8264392**	**0.6830918**	0.0000000
STRATOR1	STRATOR	0.2407459	**0.8662186**	**0.7503347**	0.0000000
STRATOR2	STRATOR	0.2683471	**0.8889786**	**0.7902830**	0.0000000
STRATOR3	STRATOR	0.2509337	**0.8716361**	**0.7597494**	0.0000000
STRATOR5	STRATOR	0.1899966	**0.7457919**	**0.5562055**	0.0000000
STRATOR6	STRATOR	0.2116433	**0.8059109**	**0.6496425**	0.0000000
INVAREA1	INVAREA	1.0000000	**1.0000000**	**1.0000000**	0.3832536
TYPINF1	TYPINF	0.1639973	**0.7628134**	**0.5818843**	0.4204548
TYPINF2	TYPINF	0.1998333	**0.8427331**	**0.7101991**	0.5131719
TYPINF3	TYPINF	0.1802707	**0.8465381**	**0.7166267**	0.5178163
TYPINF4	TYPINF	0.1746466	**0.8114926**	**0.6583741**	0.4757245
TYPINF6	TYPINF	0.1889462	**0.8462052**	**0.7160632**	0.5174091
TYPINF7	TYPINF	0.1693599	**0.8190501**	**0.6706431**	0.4847342
TYPINF8	TYPINF	0.1549525	**0.7825762**	**0.6124255**	0.4425231
PARTN2	PARTN	1.0000000	**1.0000000**	**1.0000000**	0.2946736
IAM	IAM	1.0000000	**1.0000000**	**1.0000000**	0.8681901

See the whole model

```
summary(model_plot.treatment2)
```

```
## PARTIAL LEAST SQUARES PATH MODELING (PLS-PM)
##
## ----------------------------------------------------------------
## MODEL SPECIFICATION
## 1  Number of Cases     1998
## 2  Latent Variables    9
## 3  Manifest Variables  27
## 4  Scale of Data       Standardized Data
## 5  Non-Metric PLS      TRUE
## 6  Weighting Scheme    path
## 7  Tolerance Crit      1e-07
## 8  Max Num Iters       300
## 9  Convergence Iters   4
## 10 Bootstrapping       TRUE
## 11 Bootstrap samples   100
##
## ----------------------------------------------------------------
## BLOCKS DEFINITION
##          Block       Type  Size  Mode
## 1      ASSEX Exogenous    3     A
## 2       QUAL  Exogenous    3     A
## 3  SKRELAREA  Exogenous    4     A
## 4  EVALRESP  Exogenous    2     A
## 5   STRATUR  Exogenous    5     A
## 6   INVAREA Endogenous    1     A
## 7   TYPINF Endogenous    7     A
## 8   PARTN  Endogenous    1     A
## 9    IAN  Endogenous    1     A
##
## ----------------------------------------------------------------
## BLOCKS UNIDIMENSIONALITY
##              Mode MVs C.alpha DG.rho eig.1st eig.2nd
## ASSEX           A   3   0.744  0.854   1.99   0.582
## QUAL            A   3   0.731  0.848   1.95   0.583
## SKRELAREA       A   4   0.789  0.864   2.45   0.393
## EVALRESP        A   2   0.586  0.828   1.41   0.586
## STRATUR         A   5   0.893  0.921   3.51   0.510
## INVAREA         A   1   1.000  1.000   1.00   0.000
## TYPINF          A   7   0.916  0.933   4.47   0.577
## PARTN           A   1   1.000  1.000   1.00   0.000
## IAN             A   1   1.000  1.000   1.00   0.000
##
## ----------------------------------------------------------------
## OUTER MODEL
##                weight loading communality redundancy
## ASSEX
##   1 ASSEX1      0.549   0.908       0.825       0.000
##   1 ASSEX2      0.335   0.794       0.630       0.000
##   1 ASSEX3      0.302   0.718       0.515       0.000
## QUAL
##   2 QUAL1       0.477   0.857       0.735       0.000
##   2 QUAL2       0.350   0.748       0.559       0.000
##   2 QUAL4       0.407   0.809       0.655       0.000
## SKRELAREA
##   3 SKRELAREA1  0.305   0.778       0.605       0.000
##   3 SKRELAREA2  0.296   0.755       0.570       0.000
##   3 SKRELAREA3  0.386   0.797       0.635       0.000
##   3 SKRELAREA4  0.293   0.784       0.614       0.000
## EVALRESP
##   4 EVALRESP2   0.619   0.855       0.731       0.000
##   4 EVALRESP3   0.570   0.824       0.680       0.000
## STRATUR
##   5 STRATUR1    0.246   0.864       0.750       0.000
##   5 STRATUR2    0.298   0.889       0.790       0.000
##   5 STRATUR3    0.251   0.872       0.760       0.000
##   5 STRATUR4    0.190   0.764       0.584       0.000
##   5 STRATUR5    0.212   0.805       0.648       0.000
## INVAREA
##   6 INVAREA1    1.000   1.000       1.000       0.383
## TYPINF
##   7 TYPINF1     0.166   0.763       0.582       0.420
##   7 TYPINF2     0.191   0.863       0.712       0.513
##   7 TYPINF3     0.180   0.867       0.717       0.518
##   7 TYPINF4     0.175   0.811       0.658       0.474
##   7 TYPINF5     0.189   0.864       0.714       0.517
##   7 TYPINF7     0.149   0.819       0.671       0.485
##   7 TYPINF8     0.155   0.783       0.612       0.443
## PARTN
##   8 PARTN2      1.000   1.000       1.000       0.295
## IAN
##   9 IAN         1.000   1.000       1.000       0.808
##
## ----------------------------------------------------------------
## CROSSLOADINGS
##                ASSEX   QUAL SKRELAREA EVALRESP STRATUR INVAREA TYPINF
## ASSEX
##   1 ASSEX1    0.9085 0.2852    0.2620   0.2947  0.2935  0.258  0.392
##   1 ASSEX2    0.7937 0.1749    0.1706   0.3047  0.1963  0.181  0.296
##   1 ASSEX3    0.7179 0.1281    0.1152   0.2498  0.1302  0.151  0.227
## QUAL
##   2 QUAL1     0.2246 0.8571    0.3965   0.0798  0.7359  0.322  0.703
##   2 QUAL3     0.2177 0.7679    0.3172   0.1116  0.5720  0.433  0.550
##   2 QUAL4     0.1849 0.8092    0.3579   0.0696  0.6625  0.460  0.614
## SKRELAREA
##   3 SKRELAREA1 0.1576 0.3248    0.7778   0.1222  0.3142  0.389  0.354
##   3 SKRELAREA2 0.1940 0.3141    0.7553   0.0796  0.3057  0.248  0.337
##   3 SKRELAREA3 0.2142 0.4203    0.7967   0.0983  0.4128  0.389  0.442
##   3 SKRELAREA4 0.1432 0.3143    0.7956   0.0612  0.2969  0.322  0.342
## EVALRESP
##   4 EVALRESP2 0.3148 0.0881    0.1072   0.8547  0.0488  0.127  0.144
##   4 EVALRESP3 0.2624 0.0720    0.0778   0.8246  0.0447  0.112  0.137
## STRATUR
##   5 STRATUR1  0.1943 0.7084    0.3776   0.0657  0.8642  0.347  0.726
##   5 STRATUR2  0.3853 0.7720    0.4414   0.1579  0.8890  0.433  0.848
##   5 STRATUR3  0.2133 0.7011    0.3323   0.0627  0.8714  0.342  0.730
##   5 STRATUR4  0.0872 0.5454    0.2092   0.0218  0.7458  0.279  0.571
##   5 STRATUR5  0.1414 0.6384    0.3223   0.0147  0.8050  0.465  0.617
## INVAREA
##   6 INVAREA1  0.2532 0.5879    0.4417   0.1422  0.6191  1.000  0.629
## TYPINF
##   7 TYPINF1   0.2319 0.5996    0.3531   0.0847  0.6482  0.459  0.763
##   7 TYPINF2   0.3402 0.6747    0.4204   0.1398  0.7413  0.592  0.843
##   7 TYPINF3   0.3618 0.6609    0.4247   0.1738  0.6988  0.545  0.847
##   7 TYPINF4   0.3026 0.6272    0.3967   0.1455  0.6729  0.527  0.811
##   7 TYPINF5   0.3173 0.7129    0.3709   0.1541  0.7480  0.541  0.846
##   7 TYPINF7   0.3295 0.6295    0.3793   0.1271  0.6705  0.487  0.819
##   7 TYPINF8   0.2956 0.5622    0.3807   0.1293  0.6082  0.676  0.783
## PARTN
##   8 PARTN2    0.1972 0.4985    0.3263   0.1241  0.5259  0.605  0.526
## IAN
##   9 IAN       0.2557 0.8127    0.4399   0.0822  0.8720  0.624  0.821
##              PARTN   IAN
## ASSEX
##   1 ASSEX1   0.2133 0.2758
##   1 ASSEX2   0.1340 0.1625
##   1 ASSEX3   0.0775 0.1461
## QUAL
##   2 QUAL1    0.4012 0.7514
##   2 QUAL3    0.3689 0.5515
##   2 QUAL4    0.4373 0.6419
## SKRELAREA
##   3 SKRELAREA1 0.2496 0.3138
##   3 SKRELAREA2 0.2651 0.3117
##   3 SKRELAREA3 0.2839 0.4225
##   3 SKRELAREA4 0.2046 0.3038
## EVALRESP
##   4 EVALRESP2 0.1199 0.0718
##   4 EVALRESP3 0.0876 0.0642
## STRATUR
##   5 STRATUR1  0.4601 0.7387
##   5 STRATUR2  0.5391 0.8536
##   5 STRATUR3  0.4647 0.7723
##   5 STRATUR4  0.3284 0.5945
##   5 STRATUR5  0.3954 0.6472
## INVAREA
##   6 INVAREA1  0.4052 0.6242
## TYPINF
##   7 TYPINF1   0.3841 0.4225
##   7 TYPINF2   0.4548 0.7332
##   7 TYPINF3   0.4697 0.6919
##   7 TYPINF4   0.4094 0.4770
##   7 TYPINF5   0.4604 0.7233
##   7 TYPINF7   0.4204 0.6401
##   7 TYPINF8   0.3929 0.5847
## PARTN
##   8 PARTN2    1.0000 0.5192
## IAN
##   9 IAN       0.5192 1.0000
##
## ----------------------------------------------------------------
## INNER MODEL
## [[INVAREA
##              Estimate   Std. Error    t value    Pr(>|t|)
## Intercept  -5.09e-14       0.0176  -4.67e-13   1.00e+00
## STRATUR     6.19e-01       0.0176   3.52e+01   9.69e-212
##
## [[TYPINF
##              Estimate   Std. Error    t value    Pr(>|t|)
## Intercept  -6.16e-15       0.0118  -5.21e-13   1.00e+00
## SKRELAREA   1.69e-01       0.0131   1.29e+01   5.67e-37
## STRATUR     7.79e-01       0.0131   5.96e+01   0.00e+00
##
## [[PARTN
##              Estimate   Std. Error    t value    Pr(>|t|)
## Intercept  -1.09e-14       0.0188  -5.79e-13   1.00e+00
## SKRELAREA   1.01e-01       0.0215   4.70e-03   2.76e-06
## STRATUR     4.20e-01       0.0246   1.71e+01   2.56e-61
## INVAREA     1.00e-01       0.0247   4.06e-02   5.06e-05
##
## [[IAN
##              Estimate   Std. Error    t value    Pr(>|t|)
## Intercept   1.56e-15      0.00962   1.59e-13   1.00e+00
## ASSEX      -2.39e-02      0.01129  -2.12e+00   2.18e-02
## QUAL        2.17e-01      0.01820   1.19e+01   8.91e-32
## SKRELAREA   9.58e-03      0.01154   8.30e-01   4.06e-01
## EVALRESP   -1.72e-02      0.01054  -1.63e+00   1.04e-01
## STRATUR     6.56e-01      0.02136   2.19e+01   9.02e-91
## INVAREA     6.98e-02      0.01330   5.25e+00   1.68e-07
## TYPINF      2.17e-01      0.02066   1.05e+01   3.08e-25
## PARTN       3.36e-02      0.01187   2.83e+00   4.70e-03
##
## ----------------------------------------------------------------
## CORRELATIONS BETWEEN LVs
##              ASSEX   QUAL SKRELAREA EVALRESP STRATUR INVAREA TYPINF PARTN
## ASSEX       1.000 0.2403    0.230   0.3644  0.2835  0.253  0.391 0.197
## QUAL        0.240 1.0000    0.447   0.0955  0.8209  0.588  0.777 0.498
## SKRELAREA   0.230 0.4468    1.000   0.1127  0.4204  0.442  0.478 0.326
## EVALRESP    0.364 0.0955    0.111   1.0000  0.0795  0.142  0.167 0.124
## STRATUR     0.283 0.8209    0.420   0.0795  1.0000  0.619  0.840 0.526
## INVAREA     0.253 0.5879    0.442   0.1422  0.6191  1.000  0.629 0.605
## TYPINF      0.391 0.7774    0.478   0.1668  0.8402  0.629  1.000 0.526
## PARTN       0.197 0.4985    0.326   0.1241  0.5259  0.605  0.526 1.000
## IAN         0.256 0.8127    0.440   0.0822  0.8720  0.624  0.821 0.519
##                IAN
## ASSEX       0.2557
## QUAL        0.8127
## SKRELAREA   0.4399
## EVALRESP    0.0822
## STRATUR     0.8720
## INVAREA     0.6242
## TYPINF      0.8209
## PARTN       0.5192
## IAN         1.0000
##
## ----------------------------------------------------------------
## SUMMARY INNER MODEL
##                Type   R2  Block_Communality  Mean_Redundancy   AVE
## ASSEX      Exogenous 0.000              0.657            0.000 0.657
## QUAL       Exogenous 0.000              0.650            0.000 0.650
## SKRELAREA  Exogenous 0.000              0.611            0.000 0.611
## EVALRESP   Exogenous 0.000              0.707            0.000 0.707
## STRATUR    Exogenous 0.000              0.701            0.000 0.701
## INVAREA Endogenous 0.383              1.000            0.383 1.000
## TYPINF  Endogenous 0.723              0.647            0.482 0.647
## PARTN   Endogenous 0.295              1.000            0.295 1.000
## IAN     Endogenous 0.808              1.000            0.808 1.000
##
## ----------------------------------------------------------------
## GOODNESS-OF-FIT
## [1] 0.4057
##
## ----------------------------------------------------------------
## TOTAL EFFECTS
##          relationships  direct  indirect    total
## 1        ASSEX -> QUAL 0.00000  0.00000  0.00000
## 2   ASSEX -> SKRELAREA 0.00000  0.00000  0.00000
## 3     ASSEX -> EVALRESP 0.00000  0.00000  0.00000
## 4      ASSEX -> STRATUR 0.00000  0.00000  0.00000
## 5      ASSEX -> INVAREA 0.00000  0.00000  0.00000
## 6      ASSEX -> TYPINF 0.00000  0.00000  0.00000
## 7       ASSEX -> PARTN 0.00000  0.00000  0.00000
## 8         ASSEX -> IAN -0.02592  0.00000 -0.02592
## 9      QUAL -> SKRELAREA 0.00000  0.00000  0.00000
## 10     QUAL -> EVALRESP 0.00000  0.00000  0.00000
## 11      QUAL -> STRATUR 0.00000  0.00000  0.00000
## 12     QUAL -> INVAREA 0.00000  0.00000  0.00000
## 13      QUAL -> TYPINF 0.00000  0.00000  0.00000
## 14       QUAL -> PARTN 0.00000  0.00000  0.00000
## 15         QUAL -> IAN 0.21724  0.00000  0.21724
## 16 SKRELAREA -> EVALRESP 0.00000  0.00000  0.00000
## 17  SKRELAREA -> STRATUR 0.00000  0.00000  0.00000
## 18  SKRELAREA -> INVAREA 0.00000  0.00000  0.00000
## 19  SKRELAREA -> TYPINF 0.14238  0.00000  0.1424
## 20   SKRELAREA -> PARTN 0.10111  0.00000  0.1011
## 21     SKRELAREA -> IAN 0.00968  0.03634  0.0459
## 22   EVALRESP -> STRATUR 0.00000  0.00000  0.0000
## 23   EVALRESP -> INVAREA 0.00000  0.00000  0.0000
## 24   EVALRESP -> TYPINF 0.00000  0.00000  0.0000
## 25    EVALRESP -> PARTN 0.00000  0.00000  0.0000
## 26      EVALRESP -> IAN -0.01717  0.00000 -0.0172
## 27    STRATUR -> INVAREA 0.61907  0.00000  0.6191
## 28    STRATUR -> TYPINF 0.77987  0.00000  0.7799
## 29     STRATUR -> PARTN 0.42023  0.26213  0.6824
## 30       STRATUR -> IAN 0.45430  0.23858  0.6929
## 31    INVAREA -> TYPINF 0.00000  0.00000  0.0000
## 32     INVAREA -> PARTN 0.10040  0.00000  0.1004
## 33       INVAREA -> IAN 0.06983  0.00337  0.0732
## 34       TYPINF -> PARTN 0.00000  0.00000  0.0000
## 35         TYPINF -> IAN 0.21717  0.00000  0.2172
## 36          PARTN -> IAN 0.03559  0.00000  0.0356
##
## ----------------------------------------------------------------
## BOOTSTRAP VALIDATION
## weights
##                      Original  Mean.Boot  Std.Error  perc.025  perc.975
## ASSEX-ASSEX1           0.549      0.549   1.89e-02     0.514     0.610
## ASSEX-ASSEX2           0.335      0.335   1.71e-02     0.304     0.364
## ASSEX-ASSEX3           0.302      0.302   1.73e-02     0.269     0.332
## QUAL-QUAL1             0.477      0.477   4.33e-03     0.467     0.488
## QUAL-QUAL3             0.350      0.349   4.29e-03     0.339     0.358
## QUAL-QUAL4             0.407      0.407   4.70e-03     0.395     0.419
## SKRELAREA-SKRELAREA1   0.305      0.306   7.23e-03     0.296     0.321
## SKRELAREA-SKRELAREA2   0.296      0.296   7.63e-03     0.284     0.314
```

```
## DRRELAREA~DRRELAREA4   0.384   0.385  1.12e-02   0.364   0.404
## DRRELAREA~DRRELAREA5   0.290   0.292  9.33e-03   0.274   0.305
## EVALRESP~EVALRESP2     0.619   0.625  5.24e-02   0.491   0.725
## EVALRESP~EVALRESP3     0.570   0.563  5.59e-02   0.454   0.679
## STRATOR~STRATOR1       0.246   0.246  2.84e-03   0.240   0.251
## STRATOR~STRATOR2       0.288   0.288  3.92e-03   0.280   0.296
## STRATOR~STRATOR3       0.231   0.230  3.10e-03   0.223   0.236
## STRATOR~STRATOR5       0.190   0.190  3.38e-03   0.184   0.196
## STRATOR~STRATOR6       0.212   0.212  3.22e-03   0.206   0.217
## INVAREA~INVAREA1       1.000   1.000  1.39e-16   1.000   1.000
## TYPINF~TYPINF1         0.164   0.164  2.28e-03   0.159   0.167
## TYPINF~TYPINF2         0.191   0.191  2.59e-03   0.186   0.195
## TYPINF~TYPINF3         0.180   0.180  2.98e-03   0.174   0.186
## TYPINF~TYPINF4         0.175   0.175  2.83e-03   0.170   0.180
## TYPINF~TYPINF6         0.189   0.189  2.75e-03   0.183   0.194
## TYPINF~TYPINF7         0.169   0.169  2.39e-03   0.164   0.174
## TYPINF~TYPINF8         0.155   0.155  2.82e-03   0.150   0.161
## PARTN~PARTN2           1.000   1.000  1.39e-16   1.000   1.000
## IAM~IAM                1.000   1.000  8.75e-17   1.000   1.000
##
## loadings
##
##                      Original  Mean.Boot  Std.Error  perc.025  perc.975
## ASSES~ASSES1           0.908     0.908   4.51e-03     0.894     0.920
## ASSES~ASSES2           0.796     0.796   1.59e-02     0.767     0.827
## ASSES~ASSES3           0.718     0.719   2.11e-02     0.675     0.759
## QUAL~QUAL1             0.857     0.858   1.74e-03     0.847     0.869
## QUAL~QUAL3             0.748     0.749   1.23e-02     0.727     0.769
## QUAL~QUAL4             0.809     0.809   8.54e-03     0.793     0.824
## DRRELAREA~DRRELAREA1   0.778     0.778   1.39e-02     0.753     0.802
## DRRELAREA~DRRELAREA2   0.755     0.754   1.63e-02     0.721     0.781
## DRRELAREA~DRRELAREA4   0.797     0.796   1.31e-02     0.773     0.814
## DRRELAREA~DRRELAREA5   0.796     0.795   1.24e-02     0.768     0.820
## EVALRESP~EVALRESP2     0.855     0.854   3.35e-02     0.783     0.911
## EVALRESP~EVALRESP3     0.826     0.820   3.39e-02     0.751     0.893
## STRATOR~STRATOR1       0.864     0.867   7.13e-03     0.853     0.882
## STRATOR~STRATOR2       0.889     0.888   5.39e-03     0.876     0.897
## STRATOR~STRATOR3       0.872     0.872   4.84e-03     0.859     0.885
## STRATOR~STRATOR5       0.746     0.746   1.13e-02     0.723     0.765
## STRATOR~STRATOR6       0.825     0.826   9.48e-03     0.784     0.824
## INVAREA~INVAREA1       1.000     1.000   4.64e-17     1.000     1.000
## TYPINF~TYPINF1         0.743     0.742   9.73e-03     0.745     0.780
## TYPINF~TYPINF2         0.843     0.843   7.69e-03     0.831     0.857
## TYPINF~TYPINF3         0.847     0.847   7.43e-03     0.832     0.860
## TYPINF~TYPINF4         0.811     0.813   9.37e-03     0.796     0.830
## TYPINF~TYPINF6         0.846     0.847   7.41e-03     0.831     0.859
## TYPINF~TYPINF7         0.819     0.820   8.70e-03     0.803     0.836
## TYPINF~TYPINF8         0.783     0.783   1.03e-02     0.761     0.801
## PARTN~PARTN2           1.000     1.000   5.90e-17     1.000     1.000
## IAM~IAM                1.000     1.000   5.90e-17     1.000     1.000
##
## paths
##
##                      Original  Mean.Boot  Std.Error  perc.025  perc.975
## ASSES -> IAM        -0.02592   -0.0259     0.0133  -0.05057  -0.00143
## QUAL -> IAM          0.21724    0.2143     0.0215   0.16977   0.25881
## DRRELAREA -> TYPINF  0.14258    0.1429     0.0143   0.11498   0.17533
## DRRELAREA -> PARTN   0.10111    0.0991     0.0290   0.03874   0.15054
## DRRELAREA -> IAM     0.00958    0.0112     0.0145  -0.01785   0.03941
## EVALRESP -> IAM     -0.01717   -0.0154     0.0158  -0.05291   0.01134
## STRATOR -> INVAREA   0.41907    0.4184     0.0156   0.38721   0.44547
## STRATOR -> TYPINF    0.77887    0.7795     0.0119   0.75556   0.79942
## STRATOR -> PARTN     0.42222    0.4271     0.0277   0.37090   0.48090
## STRATOR -> IAM       0.45420    0.4595     0.0245   0.40838   0.51081
## INVAREA -> PARTN     0.10040    0.0954     0.0319   0.03089   0.15425
## INVAREA -> IAM       0.04983    0.0495     0.0158   0.01937   0.08074
## TYPINF -> IAM        0.21717    0.2151     0.0253   0.16462   0.24150
## PARTN -> IAM         0.03359    0.0299     0.0140  -0.00111   0.05740
##
## r2
##                Original  Mean.Boot  Std.Error  perc.025  perc.975
## INVAREA       0.383     0.01923     0.345     0.417
## TYPINF        0.723     0.724       0.01362   0.693     0.748
## PARTN         0.295     0.298       0.01852   0.241     0.332
## IAM           0.809     0.810       0.00691   0.796     0.827
##
## total.efa
##                      Original  Mean.Boot  Std.Error  perc.025  perc.975
## ASSES -> QUAL          0.0000     0.0000     0.0000   0.00000   0.00000
## ASSES -> DRRELAREA     0.0000     0.0000     0.0000   0.00000   0.00000
## ASSES -> EVALRESP      0.0000     0.0000     0.0000   0.00000   0.00000
## ASSES -> STRATOR       0.0000     0.0000     0.0000   0.00000   0.00000
## ASSES -> INVAREA       0.0000     0.0000     0.0000   0.00000   0.00000
## ASSES -> TYPINF        0.0000     0.0000     0.0000   0.00000   0.00000
## ASSES -> PARTN         0.0000     0.0000     0.0000   0.00000   0.00000
## ASSES -> IAM          -0.0259    -0.0259     0.0133  -0.05057  -0.00143
## QUAL -> DRRELAREA      0.0000     0.0000     0.0000   0.00000   0.00000
## QUAL -> EVALRESP       0.0000     0.0000     0.0000   0.00000   0.00000
## QUAL -> STRATOR        0.0000     0.0000     0.0000   0.00000   0.00000
## QUAL -> INVAREA        0.0000     0.0000     0.0000   0.00000   0.00000
## QUAL -> TYPINF         0.0000     0.0000     0.0000   0.00000   0.00000
## QUAL -> PARTN          0.0000     0.0000     0.0000   0.00000   0.00000
## QUAL -> IAM            0.2173     0.2143     0.0215   0.16977   0.25881
## DRRELAREA -> EVALRESP  0.0000     0.0000     0.0000   0.00000   0.00000
## DRRELAREA -> STRATOR   0.0000     0.0000     0.0000   0.00000   0.00000
## DRRELAREA -> INVAREA   0.0000     0.0000     0.0000   0.00000   0.00000
## DRRELAREA -> TYPINF    0.1424     0.1429     0.0143   0.11498   0.17533
## DRRELAREA -> PARTN     0.1011     0.0991     0.0290   0.03874   0.15054
## DRRELAREA -> IAM       0.0419     0.0419     0.0150   0.01391   0.07293
## EVALRESP -> STRATOR    0.0000     0.0000     0.0000   0.00000   0.00000
## EVALRESP -> INVAREA    0.0000     0.0000     0.0000   0.00000   0.00000
## EVALRESP -> TYPINF     0.0000     0.0000     0.0000   0.00000   0.00000
## EVALRESP -> PARTN      0.0000     0.0000     0.0000   0.00000   0.00000
## EVALRESP -> IAM       -0.0172    -0.0154     0.0159  -0.05291   0.01134
## STRATOR -> INVAREA     0.4191     0.4184     0.0156   0.38721   0.44547
## STRATOR -> TYPINF      0.7789     0.7795     0.0119   0.75556   0.79942
## STRATOR -> PARTN       0.4824     0.4844     0.0213   0.43556   0.53122
## STRATOR -> IAM         0.4829     0.4847     0.0209   0.44101   0.72574
## INVAREA -> TYPINF      0.0000     0.0000     0.0000   0.00000   0.00000
## INVAREA -> PARTN       0.1004     0.0954     0.0319   0.03089   0.15425
## INVAREA -> IAM         0.0732     0.0724     0.0157   0.04280   0.09963
## TYPINF -> PARTN        0.0000     0.0000     0.0000   0.00000   0.00000
## TYPINF -> IAM          0.2172     0.2151     0.0253   0.14662   0.24150
## PARTN -> IAM           0.0334     0.0299     0.0140  -0.00111   0.05740
```

Remove EVALRESP

```
block.indicators.treatment3 <- list(
    c('ASSES1','ASSES2','ASSES3'), #ASSES
    c('QUAL1','QUAL3','QUAL4'), #QUAL
    c('DRRELAREA1', 'DRRELAREA2','DRRELAREA4','DRRELAREA5'),


    c('STRATOR1','STRATOR2','STRATOR3','STRATOR5','STRATOR6'),
    c('INVAREA1'),
    c('TYPINF1','TYPINF2','TYPINF3','TYPINF4','TYPINF6','TYPINF7','TYPINF8'),
    c('PARTN2'),
    c('IAM'))
### Escalando como numérico e nominal
scaled.treatment3 <- list(
    rep("NOM",3), #ASSES
    c("NOM", "NOM","NOM"), #QUAL
    rep("NOM",4), #DRRELAREA


    rep("NOM",5), #STRATOR
    rep("NOM",1), #INVAREA
    rep("NOM",7), #TYPINF
    c("NOM"),#PARTN
    c("NOM") #IAM
    )
modes <- rep("A",8)
path.matrix.treatment3 <- matrix(0, nrow = 8, ncol = 8)
path.matrix.treatment3[8,1:7]=1:7 # todas as variáveis explicam IAM
path.matrix.treatment3[8,8]<-0 # sem feedback
path.matrix.treatment3[7,6]<-1 # effect from INVAREA to PARTN
path.matrix.treatment3[7,3]<-1 # effect from DRRELAREA to PARTN
path.matrix.treatment3[4,6]<-1 # effect from STRATOR to TYPINF
path.matrix.treatment3[4,6]<-1 # effect from STRATOR to PARTN
path.matrix.treatment3[6,3]<-1 # effect from DRRELAREA to TYPINF
colnames(path.matrix.treatment3)<-rownames(path.matrix.treatment3)<-c("ASSES","QUAL","DRRELAREA", "STRATOR", "INVAR
EA", "TYPINF", "PARTN","IAM")
model_plot.treatment3 = plspathmake,
                    path.matrix.treatment3,
                    block.indicators.treatment3,
                    modes = modes,
                    scaling = scaled.treatment3,
                    scaled = TRUE,
                    scheme = "path",
                    tol = 1e-7, #tolerância
                    maxiter=200, #número de interações máximas
                    boot.val =TRUE, #com bootstrapping
                    br=200) #número de amostra bootstrapping
```

```
## Warning: Setting row names on a tibble is deprecated.
```

Measure Again

```
options(repr.plot.width = 1, repr.plot.height = 0.75, repr.plot.res = 100)
formattable(model_plot.treatment3$unidim , list(
    C.Alpha = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color
= "green", font.weight = "bold"))),
    DG.rho = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color
= "green", font.weight = "bold")),
    eig.1st=color_tile("white", "yellow"),
    eig.2nd=color_tile("white", "purple")
))
```

	Mode	MVs	C.alpha	DG.rho	eig.1st	eig.2nd
ASSES	A	3	**0.7463813**	**0.8556496**	1.993188	0.5923898
QUAL	A	3	**0.7311546**	**0.8481344**	1.952246	0.5834945
DRRELAREA	A	4	**0.7690320**	**0.8636029**	2.451396	0.5933478
STRATOR	A	5	**0.8828571**	**0.9214190**	3.509126	0.5102422
INVAREA	A	1	**1.0000000**	**1.0000000**	1.000000	0.0000000
TYPINF	A	7	**0.9164128**	**0.9332816**	4.667357	0.5769790
PARTN	A	1	**1.0000000**	**1.0000000**	1.000000	0.0000000
IAM	A	1	**1.0000000**	**1.0000000**	1.000000	0.0000000

Everything above is reliable.

```
options(repr.plot.width = 1, repr.plot.height = 0.75, repr.plot.res = 100)
formattable(model_plot.treatment3$outer_model, list(
    loading = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(colo
r = "green", font.weight = "bold"))),
    communality = formatter("span", style = x ~ ifelse(x < 0.5, style(color = "red", font.weight = "bold"), style(c
olor = "green", font.weight = "bold")),
    redundancy=color_tile("white", "yellow")
))
```

name	block	weight	loading	communality	redundancy
ASSES1	ASSES	0.5693484	**0.9084924**	**0.8253584**	0.0000000
ASSES2	ASSES	0.3354102	**0.7937113**	**0.6299776**	0.0000000
ASSES3	ASSES	0.3015986	**0.7173466**	**0.5144474**	0.0000000
QUAL1	QUAL	0.4767963	**0.8578977**	**0.7360165**	0.0000000
QUAL3	QUAL	0.3466599	**0.7478816**	**0.5592961**	0.0000000
QUAL4	QUAL	0.4073274	**0.8092204**	**0.6548377**	0.0000000
DRRELAREA1	DRRELAREA	0.3052010	**0.7777678**	**0.6049228**	0.0000000
DRRELAREA2	DRRELAREA	0.2963346	**0.7552487**	**0.5704605**	0.0000000
DRRELAREA4	DRRELAREA	0.3839160	**0.7967110**	**0.6347484**	0.0000000
DRRELAREA5	DRRELAREA	0.3928308	**0.7955570**	**0.6329110**	0.0000000
STRATOR1	STRATOR	0.2438702	**0.8655788**	**0.7492266**	0.0000000
STRATOR2	STRATOR	0.2860808	**0.8883276**	**0.7891259**	0.0000000
STRATOR3	STRATOR	0.2566567	**0.8714443**	**0.7594152**	0.0000000
STRATOR5	STRATOR	0.1929917	**0.7473742**	**0.5585682**	0.0000000
STRATOR6	STRATOR	0.2125809	**0.8054303**	**0.6487180**	0.0000000
INVAREA1	INVAREA	1.0000000	**1.0000000**	**1.0000000**	0.0000000
TYPINF1	TYPINF	0.1627305	**0.7621463**	**0.5808669**	0.4193585
TYPINF2	TYPINF	0.1690279	**0.8423544**	**0.7095569**	0.5122695
TYPINF3	TYPINF	0.1624143	**0.8471655**	**0.7176895**	0.5181379
TYPINF4	TYPINF	0.1733168	**0.8109038**	**0.6575550**	0.4747309
TYPINF6	TYPINF	0.1691127	**0.8462341**	**0.7161121**	0.5168991
TYPINF7	TYPINF	0.1697171	**0.8194016**	**0.6714190**	0.4847328
TYPINF8	TYPINF	0.1558314	**0.7831493**	**0.6133229**	0.4427901
PARTN2	PARTN	1.0000000	**1.0000000**	**1.0000000**	0.3062187
IAM	IAM	1.0000000	**1.0000000**	**1.0000000**	0.8077404

Everything above is reliable. # Measuring Cross-Loading

```
formattable(model_plot.treatment3$crossloadings, list(
    ASSES = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color
= "green", font.weight = "bold"))),
    QUAL = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color =
"green", font.weight = "bold")),
    DRRELAREA = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(colo
r = "green", font.weight = "bold")),
    STRATOR = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color
= "green", font.weight = "bold")),
    INVAREA = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color
= "green", font.weight = "bold")),
    TYPINF = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color =
"green", font.weight = "bold")),
    PARTN = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color =
"green", font.weight = "bold")),
    IAM = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color = "g
reen", font.weight = "bold"))
))
```

name	block	ASSES	QUAL	DRRELAREA	STRATOR	INVAREA	TYPINF	PARTN	IAM
ASSES1	ASSES	**0.90949236**	0.2852195	0.2419752	0.2829744	0.2583109	0.3913954	0.21334594	0.2758689
ASSES2	ASSES	**0.79371126**	0.1766697	0.1705911	0.1839673	0.1806873	0.2963377	0.15804331	0.1629178
ASSES3	ASSES	**0.71794654**	0.1281046	0.1151612	0.1318004	0.1558421	0.2267360	0.07734697	0.1461354
QUAL1	QUAL	0.22665591	**0.8578977**	0.3964741	0.7358062	0.5220564	0.7026841	0.44123692	0.7513652
QUAL3	QUAL	0.21770399	**0.7478816**	0.3172436	0.5719326	0.4327512	0.5496998	0.34886638	0.5514685
QUAL4	QUAL	0.19591719	**0.8092204**	0.3579004	0.6623583	0.4602966	0.6153763	0.43730244	0.6418917

name	block	ASSES	QUAL	DRRELAREA	STRATOR	INVAREA	TYPINF	PARTN	IAM
DRRELAREA1	DRRELAREA	0.15737647	0.3268242	0.7777678	0.3140785	0.3887224	0.3539015	0.24936463	0.3158245
DRRELAREA2	DRRELAREA	0.19404949	0.3160545	0.7552487	0.3007081	0.2690097	0.3369012	0.24505355	0.3117430
DRRELAREA4	DRRELAREA	0.21420450	0.4202856	0.7967110	0.4126577	0.3886660	0.4423204	0.28389268	0.4224778
DRRELAREA5	DRRELAREA	0.14325882	0.3143219	0.7955570	0.2967909	0.3215475	0.3421693	0.23435263	0.3037959
STRATOR1	STRATOR	0.19425206	0.7083836	0.3774364	0.8655788	0.5466475	0.7062582	0.46012338	0.7387467
STRATOR2	STRATOR	0.38531698	0.7720217	0.4416161	0.8883276	0.6332380	0.8474804	0.53810957	0.8555872
STRATOR3	STRATOR	0.21332791	0.7010861	0.3322671	0.8714443	0.5421386	0.7301321	0.44465175	0.7722884
STRATOR5	STRATOR	0.08718006	0.5956392	0.3091906	0.7473742	0.3788951	0.5710787	0.32838526	0.5944514
STRATOR6	STRATOR	0.16135382	0.6383505	0.3223442	0.8054303	0.4446936	0.6166277	0.39544504	0.6471823
INVAREA1	INVAREA	0.25316717	0.5878515	0.4417235	0.6186348	1.0000000	0.6288473	0.40521112	0.6241995
TYPINF1	TYPINF	0.23191187	0.5995909	0.3530823	0.6481835	0.4592227	0.7621463	0.38406808	0.6225309
TYPINF2	TYPINF	0.34016138	0.6767032	0.4253589	0.7406204	0.5501457	0.8423544	0.45476891	0.7351663
TYPINF3	TYPINF	0.36180463	0.6409032	0.4247035	0.6983824	0.5447907	0.8471655	0.46972523	0.6918666
TYPINF4	TYPINF	0.35061433	0.6072155	0.3947091	0.6726301	0.5267810	0.8109038	0.40840139	0.6769998
TYPINF6	TYPINF	0.31728345	0.7128932	0.3708609	0.7477891	0.5407062	0.8462341	0.46542493	0.7232953
TYPINF7	TYPINF	0.32945365	0.6294719	0.3793420	0.6701953	0.4872670	0.8194016	0.42041723	0.6401187
TYPINF8	TYPINF	0.29560914	0.5622277	0.3806947	0.6079318	0.4758172	0.7831493	0.39289287	0.5847492
PARTN2	PARTN	0.19719574	0.4985220	0.3263360	0.5255757	0.4052111	0.5258083	1.00000000	0.5191709
IAM	IAM	0.25565000	0.8127071	0.4399208	0.8716487	0.6241995	0.8208341	0.51917090	1.0000000

There are a lot of indicators with issues. # Measuring AVE and R^2

```
model_pls1.treatment3$inner_summary
```

```
##                 Type        R2 Block_Communality Mean_Redundancy       AVE
## ASSES      Exogenous 0.0000000         0.6569278       0.0000000 0.6569278
## QUAL       Exogenous 0.0000000         0.6495834       0.0000000 0.6495834
## DRRELAREA  Exogenous 0.0000000         0.6107457       0.0000000 0.6107457
## STRATOR    Exogenous 0.0000000         0.7010108       0.0000000 0.7010108
## INVAREA    Exogenous 0.0000000         1.0000000       0.0000000 1.0000000
## TYPINF    Endogenous 0.7219528         0.6666480       0.4812884 0.6666480
## PARTN     Endogenous 0.3062187         1.0000000       0.3062187 1.0000000
## IAM       Endogenous 0.8077404         1.0000000       0.8077404 1.0000000
```

Creating a filter to eliminate all indicators with issues.

```
select.crossloading.is.invalid <- function(df, line, col){
  maximum.line<-df %>%
    slice(line) %>%
    select(c(3:dim(df)[2])) %>%
    as.numeric %>%
    max
  #print(paste("linha",maximum.line))
  value<-df[line, col]
  #print(value)
  df<-df%>%filter(block!=col)
  maximum.column<-max(df[,col])
  #print(paste("coluna",maximum.column))
  if (value >= maximum.line && value>=maximum.column){
    return(FALSE)
  }else{
    return(TRUE)
  }
}
```

```
data.frame.removed<-tibble(
  indexes = numeric())
columns<-model_pls1.treatment3$crossloadings %>%
  select(block) %>%
  unique
for (column in columns$block){
  indicators<-model_pls1.treatment3$crossloadings %>%
    filter(block==column) %>%
    select("name")
  for (var in indicators$name){
    print(column)
    line<-which(apply(model_pls1.treatment3$crossloadings, 1, function(x) any(grep(var, x))))
    invalid<-select.crossloading.is.invalid(model_pls1.treatment3$crossloadings,
                             line,
                             column)
    #print(invalid)
      #print("##################")
      if (invalid){
        data.frame.removed<-data.frame.removed %>%
          add_row(indexes=line)
      }
  }
}
```

```
## [1] "ASSES"
## [1] "ASSES"
## [1] "ASSES"
## [1] "QUAL"
## [1] "QUAL"
## [1] "QUAL"
## [1] "DRRELAREA"
## [1] "DRRELAREA"
## [1] "DRRELAREA"
## [1] "DRRELAREA"
## [1] "STRATOR"
## [1] "STRATOR"
## [1] "STRATOR"
## [1] "STRATOR"
## [1] "STRATOR"
## [1] "INVAREA"
## [1] "TYPINF"
## [1] "TYPINF"
## [1] "TYPINF"
## [1] "TYPINF"
## [1] "TYPINF"
## [1] "TYPINF"
## [1] "TYPINF"
## [1] "PARTN"
## [1] "IAM"
```

```
indexes<-seq(1,dim(model_pls1.treatment3$crossloading)[1])
indexes <- indexes[which(!indexes %in% data.frame.removed$indexes)]
final.variables<-model_pls1.treatment3$crossloadings %>%
  slice(indexes)
```

Plot the output of cross-loadings

```
# load ggplot2 and reshape
library(ggplot2)
```

```
##
## Attaching package: 'ggplot2'
```

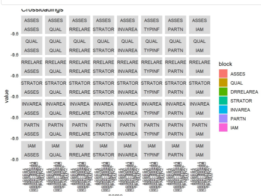
```
## The following object is masked from 'package:plspm':
##
##     alpha
```

```
library(reshape)
```

```
##
## Attaching package: 'reshape'
```

```
## The following object is masked from 'package:dplyr':
##
##     rename
```

```
# reshape crossloadings data.frame for ggplot
xloads = melt(final.variables, id.vars = c("name", "block"),
variable_name = "LV")
# bar-charts of crossloadings by block
ggplot(data = xloads,
aes(x = name, y = value, fill = block)) +
geom_hline(yintercept = 0, color = "gray75") +
geom_hline(yintercept = c(-0.5, 0.5), color = "gray70", linetype = 2) +
geom_bar(stat = 'identity', position = 'dodge') +
facet_wrap(block ~ LV) +
theme(axis.text.x = element_text(angle = 90),
line = element_blank()) +
ggtitle("Crossloadings")
```



Measuring the remanings variables

after cross-loadings filtering # Bootstrapping # Final Model # Structural Model Validation beginning

```
block.indicators.final <- list(
    c('ASSES1','ASSES2', 'ASSES3'),
    c('QUAL1'),
    c('DRRELAREA1','DRRELAREA2','DRRELAREA4','DRRELAREA5'),

    c('STRATOR2'),
    c('INVAREA1'),
    c("PARTN2"),
   c('IAM'))
### Escalando como numérico e nominal
scaled.final <-list(
    rep("NOM",3), #ASSES
    c("NOM"), #QUAL
    rep("NOM",4), #DRRELAREA

    rep("NOM",1), #STRATOR
    rep("NOM",1), #INVAREA
    rep("NOM",1), #PARTN
    c("NUM") #IAM
    )
modes <- rep("A",7)
path.matrix.final <- matrix(0, nrow = 7, ncol = 7)
path.matrix.final[7,]<-rep(1,7) # todas as variáveis explicam IAM
path.matrix.final[7,7]<-0 # sem feeedback
path.matrix.final[6,3]<-1 # effect from DRRELAREA to PARTN
path.matrix.final[6,4]<-1 # effect from STRATOR to PARTN
colnames(path.matrix.final)=rownames(path.matrix.final)<-c("ASSES","QUAL","DRRELAREA", "STRATOR", "INVAREA", "PART
N", "IAM")
model_pls1.final = plspm(table,
                    path.matrix.final,
                    block.indicators.final,
                    modes = modes,
                    scaling = scaled.final,
                    scaled = TRUE,
                    scheme = "path",
                    tol = 1e-7, #tolerância
                    maxiter=300, #número de interações máximas
                    boot.val =TRUE, #com bootstrapping
                    br=5000) #número de amostra bootstrapping
```

```
## Warning: Setting row names on a tibble is deprecated.
```

Summary whole model

```
summary(model_pls1.final)
```

```
## PARTIAL LEAST SQUARES PATH MODELING (PLS-PM)
##
## ---------------------------------------------------------------
## MODEL SPECIFICATION
## 1   Number of Cases     1998
## 2   Latent Variables    7
## 3   Manifest Variables  12
## 4   Scale of Data       Standardized Data
## 5   Non-Metric PLS      TRUE
## 6   Weighting Scheme    path
## 7   Tolerance Crit      1e-07
## 8   Max Num Iters       300
## 9   Convergence Iters   3
## 10  Bootstrapping       TRUE
## 11  Bootstrap samples   5000
##
## ---------------------------------------------------------------
## BLOCK DEFINITION
##        Block          Type  Size  Mode
## 1     ASSES   Exogenous     3     A
## 2     QUAL    Exogenous     1     A
## 3   DRRELAREA  Exogenous     4     A
## 4   STRATOR   Exogenous     1     A
## 5   INVAREA   Exogenous     1     A
## 6    PARTS    Endogenous    1     A
## 7    IAN      Endogenous    1     A
##
## ---------------------------------------------------------------
## BLOCK UNIDIMENSIONALITY
##              Mode  MVs  C.alpha  DG.rho  eig.1st  eig.2nd
## ASSES         A    3    0.744   0.854    1.98     0.592
## QUAL          A    1    1.000   1.000    1.00     0.000
## DRRELAREA     A    4    0.789   0.864    2.45     0.593
## STRATOR       A    1    1.000   1.000    1.00     0.000
## INVAREA       A    1    1.000   1.000    1.00     0.000
## PARTS         A    1    1.000   1.000    1.00     0.000
## IAN           A    1    1.000   1.000    1.00     0.000
##
## ---------------------------------------------------------------
## OUTER MODEL
##                weight  loading  communality  redundancy
## ASSES
##   1 ASSES1      0.549    0.908        0.825       0.000
##   1 ASSES2      0.335    0.794        0.630       0.000
##   1 ASSES3      0.302    0.718        0.515       0.000
## QUAL
##   2 QUAL1       1.000    1.000        1.000       0.000
## DRRELAREA
##   3 DRRELAREA1  0.306    0.777        0.604       0.000
##   3 DRRELAREA2  0.330    0.757        0.573       0.000
##   3 DRRELAREA3  0.386    0.797        0.635       0.000
##   3 DRRELAREA4  0.290    0.784        0.615       0.000
## STRATOR
##   4 STRATOR2    1.000    1.000        1.000       0.000
## INVAREA
##   5 INVAREA1    1.000    1.000        1.000       0.000
## PARTS
##   6 PARTS2      1.000    1.000        1.000       0.299
## IAN
##   7 IAN         1.000    1.000        1.000       0.866
##
## ---------------------------------------------------------------
## CROSSLOADINGS
##                ASSES  QUAL  DRRELAREA  STRATOR  INVAREA  PARTS   IAN
## ASSES
##   1 ASSES1    0.908  0.421      0.342    0.395    0.298  0.2133  0.276
##   1 ASSES2    0.794  0.303      0.171    0.279    0.141  0.1560  0.143
##   1 ASSES3    0.718  0.298      0.115    0.222    0.191  0.0775  0.146
## QUAL
##   2 QUAL1     0.413  1.000      0.494    0.913    0.678  0.5564  0.908
## DRRELAREA
##   3 DRRELAREA1  0.157  0.365      0.777    0.326    0.389  0.2494  0.314
##   3 DRRELAREA2  0.194  0.352      0.757    0.323    0.249  0.2451  0.312
##   3 DRRELAREA3  0.214  0.446      0.797    0.402    0.389  0.2829  0.422
##   3 DRRELAREA4  0.163  0.339      0.784    0.314    0.322  0.2346  0.304
## STRATOR
##   4 STRATOR2    0.385  0.913      0.462    1.000    0.433  0.5381  0.856
## INVAREA
##   5 INVAREA1    0.253  0.678      0.462    0.433    1.000  0.4052  0.624
## PARTS
##   6 PARTS2      0.197  0.557      0.326    0.538    0.405  1.0000  0.519
## IAN
##   7 IAN         0.256  0.908      0.440    0.856    0.624  0.5192  1.000
##
## ---------------------------------------------------------------
## INNER MODEL
## [ASSES]
##              Estimate   Std. Error    t value    Pr(>|t|)
## Intercept   -7.68e-16       0.0197   -4.13e-11   1.00e+00
## DRRELAREA    1.10e-01       0.0209    5.28e-07   1.46e-07
## STRATOR      4.89e-01       0.0209    2.34e-01   1.92e-167
##
## [QUAL]
##              Estimate   Std. Error    t value    Pr(>|t|)
## Intercept  -2.13e-15       0.00878   -2.43e-13   1.00e+00
## ASSES      -1.46e-01       0.00947   -1.54e-01   2.19e-48
## QUAL        8.15e-01       0.02276    3.43e-01   3.27e-203
## DRRELAREA  -5.06e-03       0.01028   -4.93e-01   6.24e-01
## STRATOR     1.43e-01       0.02170    7.51e-02   9.06e-14
## INVAREA     4.32e-03       0.01216    3.54e-01   7.23e-01
## PARTS       6.17e-03       0.01046    5.78e-01   5.62e-01
##
## ---------------------------------------------------------------
## CORRELATIONS BETWEEN LVs
##              ASSES   QUAL  DRRELAREA  STRATOR  INVAREA  PARTS   IAN
## ASSES       1.000  0.413      0.230    0.385    0.253  0.197  0.256
## QUAL        0.413  1.000      0.494    0.913    0.678  0.557  0.908
## DRRELAREA   0.230  0.494      1.000    0.462    0.462  0.326  0.440
## STRATOR     0.385  0.913      0.462    1.000    0.433  0.538  0.856
## INVAREA     0.253  0.678      0.462    0.433    1.000  0.405  0.624
## PARTS       0.197  0.557      0.326    0.538    0.405  1.000  0.519
## IAN         0.256  0.908      0.440    0.856    0.624  0.519  1.000
##
## ---------------------------------------------------------------
## SUMMARY INNER MODEL
##                Type     R2  Block_Communality  Mean_Redundancy    AVE
## ASSES      Exogenous  0.000              0.657            0.000  0.657
## QUAL       Exogenous  0.000              1.000            0.000  1.000
## DRRELAREA  Exogenous  0.000              0.611            0.000  0.611
## STRATOR    Exogenous  0.000              1.000            0.000  1.000
## INVAREA    Exogenous  0.000              1.000            0.000  1.000
## PARTS      Endogenous 0.299              1.000            0.299  1.000
## IAN        Endogenous 0.866              1.000            0.866  1.000
##
## ---------------------------------------------------------------
## GOODNESS-OF-FIT
## [1] 0.485
##
## ---------------------------------------------------------------
## TOTAL EFFECTS
##              relationships    direct  indirect     total
## 1          ASSES -> QUAL   0.00000  0.000000   0.00000
## 2     ASSES -> DRRELAREA   0.00000  0.000000   0.00000
## 3        ASSES -> STRATOR  0.00000  0.000000   0.00000
## 4        ASSES -> INVAREA  0.00000  0.000000   0.00000
## 5          ASSES -> PARTS  0.00000  0.000000   0.00000
## 6           ASSES -> IAN  -0.14534  0.000000  -0.14534
## 7          QUAL -> DRRELAREA  0.00000  0.000000   0.00000
## 8        QUAL -> STRATOR   0.00000  0.000000   0.00000
## 9        QUAL -> INVAREA   0.00000  0.000000   0.00000
## 10         QUAL -> PARTS   0.00000  0.000000   0.00000
## 11          QUAL -> IAN    0.81544  0.000000   0.81544
## 12    DRRELAREA -> STRATOR  0.00000  0.000000   0.00000
## 13    DRRELAREA -> INVAREA  0.00000  0.000000   0.00000
## 14    DRRELAREA -> PARTS    0.11023  0.000000   0.11023
## 15     DRRELAREA -> IAN    -0.00504  0.000681  -0.00436
## 16    STRATOR -> INVAREA    0.00000  0.000000   0.00000
## 17    STRATOR -> PARTS      0.48942  0.000000   0.48942
## 18     STRATOR -> IAN       0.14294  0.003222   0.14596
## 19    INVAREA -> PARTS      0.00000  0.000000   0.00000
## 20     INVAREA -> IAN       0.00432  0.000000   0.00432
## 21      PARTS -> IAN        0.20417  0.000000   0.20417
##
## ---------------------------------------------------------------
## BOOTSTRAP VALIDATION
## weights
##                          Original  Mean.Boot  Std.Error  perc.025  perc.975
## ASSES-ASSES1                0.549      0.570    1.83e-02     0.535     0.607
## ASSES-ASSES2                0.335      0.335    1.73e-02     0.300     0.369
## ASSES-ASSES3                0.302      0.301    1.83e-02     0.266     0.336
## QUAL-QUAL1                  1.000      1.000    8.84e-17     1.000     1.000
## DRRELAREA-DRRELAREA1        0.306      0.306    1.55e-02     0.285     0.325
## DRRELAREA-DRRELAREA2        0.330      0.330    1.09e-02     0.280     0.320
## DRRELAREA-DRRELAREA3        0.386      0.385    1.24e-02     0.360     0.410
## DRRELAREA-DRRELAREA4        0.290      0.290    9.45e-03     0.272     0.309
## STRATOR-STRATOR2            1.000      1.000    1.38e-16     1.000     1.000
## INVAREA-INVAREA1            1.000      1.000    9.69e-17     1.000     1.000
## PARTS-PARTS2                1.000      1.000    1.13e-16     1.000     1.000
## IAN-IAN                     1.000      1.000    7.15e-17     1.000     1.000
##
## loadings
##                          Original  Mean.Boot  Std.Error  perc.025  perc.975
## ASSES-ASSES1                0.908      0.909    4.34e-03     0.896     0.920
## ASSES-ASSES2                0.794      0.793    1.64e-02     0.759     0.823
## ASSES-ASSES3                0.718      0.717    2.04e-02     0.675     0.754
## QUAL-QUAL1                  1.000      1.000    6.14e-17     1.000     1.000
## DRRELAREA-DRRELAREA1        0.777      0.777    1.46e-02     0.746     0.803
## DRRELAREA-DRRELAREA2        0.757      0.757    1.53e-02     0.726     0.786
## DRRELAREA-DRRELAREA4        0.797      0.797    1.18e-02     0.773     0.820
## DRRELAREA-DRRELAREA3        0.784      0.784    1.38e-02     0.756     0.810
## STRATOR-STRATOR2            1.000      1.000    9.79e-17     1.000     1.000
## INVAREA-INVAREA1            1.000      1.000    6.24e-17     1.000     1.000
## PARTS-PARTS2                1.000      1.000    9.69e-17     1.000     1.000
## IAN-IAN                     1.000      1.000    4.87e-17     1.000     1.000
##
## paths
##                        Original  Mean.Boot  Std.Error  perc.025  perc.975
## ASSES -> IAN          -0.14534  -0.14092     0.0120   -0.1446   -0.1172
## QUAL -> IAN            0.81544   0.82201     0.0304    0.7614    0.8812
## DRRELAREA -> PARTS     0.11023   0.11061     0.0272    0.0586    0.1628
## DRRELAREA -> IAN      -0.00504  -0.00474     0.0115   -0.0303    0.0220
## STRATOR -> PARTS       0.48942   0.48933     0.0202    0.4492    0.5288
## STRATOR -> IAN         0.14294   0.15484     0.0292    0.0961    0.2140
## INVAREA -> IAN         0.00432   0.00464     0.0151   -0.0249    0.0345
## PARTS -> IAN           0.20417   0.20546     0.0133   -0.0200    0.0312
##
## xaq
##              Original  Mean.Boot  Std.Error  perc.025  perc.975
## PARTS       0.299      0.300      0.01449    0.268     0.336
## IAN         0.866      0.851      0.00719    0.837     0.865
##
## total.efs
##                          Original  Mean.Boot  Std.Error  perc.025  perc.975
## ASSES -> QUAL             0.00000   0.00000     0.0000    0.0000    0.0000
## ASSES -> DRRELAREA        0.00000   0.00000     0.0000    0.0000    0.0000
## ASSES -> STRATOR          0.00000   0.00000     0.0000    0.0000    0.0000
## ASSES -> INVAREA          0.00000   0.00000     0.0000    0.0000    0.0000
## ASSES -> PARTS            0.00000   0.00000     0.0000    0.0000    0.0000
## ASSES -> IAN             -0.14534  -0.14092     0.0120   -0.1446   -0.1172
## QUAL -> DRRELAREA         0.00000   0.00000     0.0000    0.0000    0.0000
## QUAL -> STRATOR           0.00000   0.00000     0.0000    0.0000    0.0000
## QUAL -> INVAREA           0.00000   0.00000     0.0000    0.0000    0.0000
## QUAL -> PARTS             0.00000   0.00000     0.0000    0.0000    0.0000
## QUAL -> IAN               0.81544   0.82201     0.0304    0.7614    0.8812
## DRRELAREA -> STRATOR      0.00000   0.00000     0.0000    0.0000    0.0000
## DRRELAREA -> INVAREA      0.00000   0.00000     0.0000    0.0000    0.0000
## DRRELAREA -> PARTS        0.11023   0.11061     0.0272    0.0586    0.1628
## DRRELAREA -> IAN         -0.00436  -0.00411     0.0105   -0.0302    0.0225
## STRATOR -> INVAREA        0.00000   0.00000     0.0000    0.0000    0.0000
## STRATOR -> PARTS          0.48942   0.48933     0.0202    0.4492    0.5288
## STRATOR -> IAN            0.14596   0.15963     0.0294    0.1014    0.2171
## INVAREA -> PARTS          0.00000   0.00000     0.0000    0.0000    0.0000
## INVAREA -> IAN            0.00432   0.00464     0.0151   -0.0249    0.0345
## PARTS -> IAN              0.20417   0.20546     0.0133   -0.0200    0.0312
```

Fornell-Lacker Criterion

```
# Fornell-Lacker - validade discriminante
# sqrt of AVE
sqrt(model_plsf.finalInner_summary$AVE)
```

```
## [1] 0.8105108 1.0000000 0.7814484 1.0000000 1.0000000 1.0000000 1.0000000
```

Coefficient of Determination

```
model_plsf.finalInner_summary[, "R2", drop = FALSE]
```

```
##                R2
## ASSES   0.0000000
## QUAL    0.0000000
## DRRELAREA 0.0000000
## STRATOR   0.0000000
## INVAREA   0.0000000
## PARTS     0.2993411
## IAN       0.9664210
```

Outer Model

```
options(repr.plot.width = 1, repr.plot.height = 0.75, repr.plot.res = 500)
fornaltable(model_plsf.finalOuter_model, list(
loading = formatter("span", style = x ~ ifelse(x < 0.7, style(color = "red", font.weight = "bold"), style(color = "green", font.weight = "bold"))),
communality = formatter("span", style = x ~ ifelse(x < 0.5, style(color = "red", font.weight = "bold"), style(colo
r = "green", font.weight = "bold"))),
redundancy=color_tile("white", "yellow")
))
```

name	block	weight	loading	communality	redundancy
ASSES1	ASSES	0.5693484	**0.9084924**	**0.8253954**	0.0000000
ASSES2	ASSES	0.3354102	**0.7927113**	**0.6279776**	0.0000000
ASSES3	ASSES	0.3015996	**0.7179466**	**0.5154474**	0.0000000
QUAL1	QUAL	1.0000000	**1.0000000**	**1.0000000**	0.0000000
DRRELAREA1	DRRELAREA	0.3041415	**0.7770406**	**0.6037921**	0.0000000
DRRELAREA2	DRRELAREA	0.2997206	**0.7569246**	**0.5729346**	0.0000000
DRRELAREA4	DRRELAREA	0.3944893	**0.7909075**	**0.6256615**	0.0000000
DRRELAREA3	DRRELAREA	0.2900756	**0.7943445**	**0.6309832**	0.0000000
STRATOR2	STRATOR	1.0000000	**1.0000000**	**1.0000000**	0.0000000
INVAREA1	INVAREA	1.0000000	**1.0000000**	**1.0000000**	0.0000000

name	block	weight	loading	communality	redundancy
PARTN2	PARTN	1.0000000	**1.0000000**	**1.0000000**	0.2993411
IAM	IAM	1.0000000	**1.0000000**	**1.0000000**	0.8464210

Inner Summary

```
model_pls1.final$inner_summary
```

```
##                Type        R2 Block_Communality Mean_Redundancy       AVE
## ASSES      Exogenous 0.0000000         0.6569278       0.0000000 0.6569278
## QUAL       Exogenous 0.0000000         1.0000000       0.0000000 1.0000000
## DRRELAREA  Exogenous 0.0000000         0.6106929       0.0000000 0.6106929
## STRATOR    Exogenous 0.0000000         1.0000000       0.0000000 1.0000000
## INVAREA    Exogenous 0.0000000         1.0000000       0.0000000 1.0000000
## PARTN     Endogenous 0.2993411         1.0000000       0.2993411 1.0000000
## IAM       Endogenous 0.8464210         1.0000000       0.8464210 1.0000000
```

Effects

```
model_pls1.final$effects
```

```
##          relationships       direct     indirect        total
## 1          ASSES -> QUAL  0.000000000 0.0000000000  0.000000000
## 2     ASSES -> DRRELAREA  0.000000000 0.0000000000  0.000000000
## 3       ASSES -> STRATOR  0.000000000 0.0000000000  0.000000000
## 4       ASSES -> INVAREA  0.000000000 0.0000000000  0.000000000
## 5         ASSES -> PARTN  0.000000000 0.0000000000  0.000000000
## 6           ASSES -> IAM -0.145341258 0.0000000000 -0.145341258
## 7      QUAL -> DRRELAREA  0.000000000 0.0000000000  0.000000000
## 8        QUAL -> STRATOR  0.000000000 0.0000000000  0.000000000
## 9        QUAL -> INVAREA  0.000000000 0.0000000000  0.000000000
## 10         QUAL -> PARTN  0.000000000 0.0000000000  0.000000000
## 11           QUAL -> IAM  0.815441920 0.0000000000  0.815441920
## 12 DRRELAREA -> STRATOR  0.000000000 0.0000000000  0.000000000
## 13 DRRELAREA -> INVAREA  0.000000000 0.0000000000  0.000000000
## 14   DRRELAREA -> PARTN  0.110226548 0.0000000000  0.110226548
## 15     DRRELAREA -> IAM -0.005040801 0.0006805696 -0.004360232
## 16   STRATOR -> INVAREA  0.000000000 0.0000000000  0.000000000
## 17     STRATOR -> PARTN  0.489419400 0.0000000000  0.489419400
## 18       STRATOR -> IAM  0.162938735 0.0030218123  0.165960548
## 19     INVAREA -> PARTN  0.000000000 0.0000000000  0.000000000
## 20       INVAREA -> IAM  0.004324685 0.0000000000  0.004324685
## 21         PARTN -> IAM  0.006174280 0.0000000000  0.006174280
```

```
library("parameters")
```

```
##
## Attaching package: 'parameters'
```

```
## The following object is masked from 'package:plspm':
##
##     get_scores
```

```
model_pls1.final$effects[c(6,11, 14,15,17,18,20,21),]
```

```
##        relationships       direct     indirect        total
## 6        ASSES -> IAM -0.145341258 0.0000000000 -0.145341258
## 11        QUAL -> IAM  0.815441920 0.0000000000  0.815441920
## 14 DRRELAREA -> PARTN  0.110226548 0.0000000000  0.110226548
## 15   DRRELAREA -> IAM -0.005040801 0.0006805696 -0.004360232
## 17   STRATOR -> PARTN  0.489419400 0.0000000000  0.489419400
## 18     STRATOR -> IAM  0.162938735 0.0030218123  0.165960548
## 20     INVAREA -> IAM  0.004324685 0.0000000000  0.004324685
## 21       PARTN -> IAM  0.006174280 0.0000000000  0.006174280
```

Filtering by the relevant effects (above or equal 0.1) - IAM

```
model_pls1.final.relevants<-model_pls1.final$effects[c(6,11, 14,15,17,18,20,21),] %>% filter(abs(total)>=0.1)
model_pls1.final.relevants
```

```
##       relationships     direct    indirect      total
## 1       ASSES -> IAM -0.1453413 0.000000000 -0.1453413
## 2        QUAL -> IAM  0.8154419 0.000000000  0.8154419
## 3 DRRELAREA -> PARTN  0.1102265 0.000000000  0.1102265
## 4   STRATOR -> PARTN  0.4894194 0.000000000  0.4894194
## 5     STRATOR -> IAM  0.1629387 0.003021812  0.1659605
```

SIZE EFFECTS

```
model.filtered<-model_pls1.final$scores %>% as.data.frame %>%select(ASSES, QUAL, STRATOR, IAM)
model <- aov(IAM~., data=model.filtered)
eta_squared(model)
```

```
## # Effect Size for ANOVA (Type I)
##
## Parameter | Eta2 (partial) |       95% CI
## -----------------------------------------
## ASSES     |           0.30 | [0.22, 1.00]
## QUAL      |           0.83 | [0.83, 1.00]
## STRATOR   |           0.03 | [0.02, 1.00]
##
## - One-sided CIs: upper bound fixed at [1.00].
```

The size effects is big for QUAL, moderate for ASSES and small for STRATOR

```
options(es.use_symbols = TRUE)
m <- lm(IAM~., data = model.filtered)
parameters::model_parameters(anova(m))
```

```
## Parameter | Sum_Squares |   df | Mean_Square |        F |      p
## ----------------------------------------------------------------
## ASSES     |      130.58 |    1 |      130.58 |   848.30 | < .001
## QUAL      |     1551.49 |    1 |     1551.49 | 10078.83 | < .001
## STRATOR   |        8.98 |    1 |        8.98 |    58.33 | < .001
## Residuals |      306.95 | 1994 |        0.15 |          |
##
## Anova Table (Type 1 tests)
```

```
cohens_f_squared(anova(m))
```

```
## # Effect Size for ANOVA (Type I)
##
## Parameter | Cohen's f² (partial) |      95% CI
## ----------------------------------------------
## ASSES     |                 0.43 | [0.28, Inf]
## QUAL      |                 5.05 | [4.75, Inf]
## STRATOR   |                 0.03 | [0.02, Inf]
##
## - One-sided CIs: upper bound fixed at [Inf].
```

Filtering by the relevant effects (above or equal 0.1) - PARTN

```
model_pls1.final.relevants<-model_pls1.final$effects[c(6,11, 14,15,17,18,20,21),] %>% filter(abs(total)>=0.1)
model_pls1.final.relevants<-model_pls1.final.relevants[c(3,4),]
model_pls1.final.relevants
```

```
##       relationships    direct indirect     total
## 3 DRRELAREA -> PARTN 0.1102265        0 0.1102265
## 4   STRATOR -> PARTN 0.4894194        0 0.4894194
```

```
model.filtered<-model_pls1.final$scores %>% as.data.frame %>%select(DRRELAREA, STRATOR, PARTN)
model <- aov(PARTN~., data=model.filtered)
eta_squared(model)
```

```
## # Effect Size for ANOVA (Type I)
##
## Parameter | η² (partial) |       95% CI
## ---------------------------------------
## DRRELAREA |         0.13 | [0.11, 1.00]
## STRATOR   |         0.22 | [0.19, 1.00]
##
## - One-sided CIs: upper bound fixed at [1.00].
```

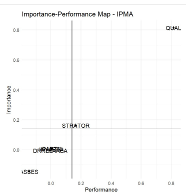
```
options(es.use_symbols = TRUE)
m <- lm(PARTN~., data = model.filtered)
parameters::model_parameters(anova(m))
```

```
## Parameter | Sum_Squares |   df | Mean_Square |      F |      p
## --------------------------------------------------------------
## DRRELAREA |      212.88 |    1 |      212.88 | 303.38 | < .001
## STRATOR   |      385.20 |    1 |      385.20 | 548.94 | < .001
## Residuals |     1399.92 | 1995 |        0.70 |        |
##
## Anova Table (Type 1 tests)
```

```
cohens_f_squared(anova(m))
```

```
## # Effect Size for ANOVA (Type I)
##
## Parameter | Cohen's f² (partial) |      95% CI
## ----------------------------------------------
## DRRELAREA |                 0.15 | [0.12, Inf]
## STRATOR   |                 0.28 | [0.24, Inf]
##
## - One-sided CIs: upper bound fixed at [Inf].
```

```
betas<-model_pls1.final$path_coefs[c(7),c(1,2,3,4,5,6)]
efeitos<-model_pls1.final$effects[c(6,11,15,18,20,21),]$total
df<-data.frame(betas, efeitos)
colnames(df)<-c("BETAS","EFFECTS")
p<-ggplot(df, aes(x=efeitos, y=betas)) +
  geom_point() +
  #lims(x=c(0.67517,0.67517),y=c(-0.44522,0.44522)) +
  theme_minimal() +
  coord_fixed() +
  geom_vline(xintercept = mean(df$EFFECTS)) + geom_hline(yintercept = mean(df$BETAS)) +
    geom_text(label=rownames(df))   +
     labs(title = "Importance-Performance Map - IPMA", x = "Performance", y = "Importance")
p
```




```
#png("ipma.png")
#print(p)
#dev.off()
```

Validation - GOF

```
model_pls1.final$gof
```

```
## [1] 0.6010042
```

Validation Confidence Interval - Weights

```
model_pls1.final$boot$weights
```

```
##                          Original Mean.Boot    Std.Error  perc.025  perc.975
## ASSES-ASSES1            0.5693484 0.5696518 1.851340e-02 0.5347147 0.6073409
## ASSES-ASSES2            0.3354102 0.3353772 1.729745e-02 0.3002725 0.3690195
## ASSES-ASSES3            0.3015996 0.3012365 1.827823e-02 0.2643415 0.3362204
## QUAL-QUAL1              1.0000000 1.0000000 8.840937e-17 1.0000000 1.0000000
## DRRELAREA-DRRELAREA1 0.3041415 0.3041596 1.001102e-02 0.2851664 0.3246121
## DRRELAREA-DRRELAREA2 0.2997206 0.2995492 1.002234e-02 0.2803946 0.3196630
## DRRELAREA-DRRELAREA4 0.3844680 0.3845445 1.263236e-02 0.3603010 0.4101193
## DRRELAREA-DRRELAREA5 0.2900736 0.2901152 9.446770e-03 0.2715867 0.3086317
## STRATOR-STRATOR2        1.0000000 1.0000000 1.352513e-16 1.0000000 1.0000000
## INVAREA-INVAREA1        1.0000000 1.0000000 9.399225e-17 1.0000000 1.0000000
## PARTN-PARTN2            1.0000000 1.0000000 1.327766e-16 1.0000000 1.0000000
## IAM-IAM                 1.0000000 1.0000000 7.149379e-17 1.0000000 1.0000000
```

Validation Confidence Interval - Loadings

```
model_pls1.final$boot$loadings
```

```
##                        Original Mean.Boot    Std.Error  perc.025  perc.975
## ASSES-ASSES1         0.9084924 0.9085238 6.360267e-03 0.8958937 0.9204326
## ASSES-ASSES2         0.7937113 0.7932530 1.637929e-02 0.7592036 0.8233365
## ASSES-ASSES3         0.7179466 0.7169134 2.043707e-02 0.6749001 0.7543292
## QUAL-QUAL1           1.0000000 1.0000000 6.138049e-17 1.0000000 1.0000000
## DRRELAREA-DRRELAREA1 0.7770406 0.7765814 1.461981e-02 0.7457824 0.8034008
## DRRELAREA-DRRELAREA2 0.7569246 0.7567454 1.533830e-02 0.7258140 0.7860444
## DRRELAREA-DRRELAREA4 0.7969075 0.7970508 1.175878e-02 0.7729182 0.8195186
## DRRELAREA-DRRELAREA5 0.7943445 0.7942422 1.378347e-02 0.7656624 0.8202809
## STRATOR-STRATOR2     1.0000000 1.0000000 5.765190e-17 1.0000000 1.0000000
## INVAREA-INVAREA1     1.0000000 1.0000000 6.241618e-17 1.0000000 1.0000000
## PARTN-PARTN2         1.0000000 1.0000000 5.824758e-17 1.0000000 1.0000000
## IAM-IAM              1.0000000 1.0000000 4.865240e-17 1.0000000 1.0000000
```

Validation Confidence Interval - Path Coefficients

```
model_pls1.final$boot$paths
```

```
##                        Original    Mean.Boot  Std.Error    perc.025    perc.975
## ASSES -> IAM       -0.145341258 -0.140919494 0.01197759 -0.16442818 -0.11722157
## QUAL -> IAM         0.815441920  0.822005587 0.03035496  0.76161212  0.88123087
## DRRELAREA -> PARTN  0.110226548  0.110608664 0.02716784  0.05855898  0.16280222
## DRRELAREA -> IAM   -0.005040801 -0.004736725 0.01349631 -0.03133781  0.02203857
## STRATOR -> PARTN    0.489419400  0.489330261 0.02022612  0.44922179  0.52881057
## STRATOR -> IAM      0.162938735  0.156859720 0.02916544  0.09811978  0.21398926
## INVAREA -> IAM      0.004324685  0.004444941 0.01513741 -0.02491957  0.03445651
## PARTN -> IAM        0.006174280  0.005662115 0.01326522 -0.02001736  0.03116870
```

Validation Confidence Interval - R^2

```
model_pls1.final$boot$rsq
```

```
##        Original Mean.Boot   Std.Error  perc.025  perc.975
## PARTN 0.2993411 0.3002871 0.016487672 0.2683281 0.3336484
## IAM   0.8464210 0.8513820 0.007185134 0.8366837 0.8652052
```

Validation Confidence Interval - Effects

```
model_pls1.final$boot$total.efs[c(6,11,14,15,17,18,20,21),]
```

```
##                        Original    Mean.Boot  Std.Error    perc.025    perc.975
## ASSES -> IAM       -0.145341258 -0.140919494 0.01197759 -0.16442818 -0.11722157
## QUAL -> IAM         0.815441920  0.822005587 0.03035496  0.76161212  0.88123087
## DRRELAREA -> PARTN  0.110226548  0.110608664 0.02716784  0.05855898  0.16280222
## DRRELAREA -> IAM   -0.004360232 -0.004107986 0.01345758 -0.03017231  0.02249059
## STRATOR -> PARTN    0.489419400  0.489330261 0.02022612  0.44922179  0.52881057
## STRATOR -> IAM      0.165960548  0.159630313 0.02936689  0.10140028  0.21714170
## INVAREA -> IAM      0.004324685  0.004444941 0.01513741 -0.02491957  0.03445651
## PARTN -> IAM        0.006174280  0.005662115 0.01326522 -0.02001736  0.03116870
```

Validation Confidence Interval - Hypotheses Final

```
formattable(model_pls1.final$boot$total.efs[c(6,11,14,15,17,18,20,21),], list(
  Mean.Boot = formatter("span",
    style = x ~ style(color = ifelse(abs(x)<0.1, "red", "green")),
    x ~ icontext(ifelse(abs(x)<0.1, "remove", "ok"), ifelse(abs(x)<0.1, "Reject", "Accept")))
))
```

	Original	Mean.Boot	Std.Error	perc.025	perc.975
ASSES -> IAM	-0.145341258	✔ Accept	0.01197759	-0.16442818	-0.11722157
QUAL -> IAM	0.815441920	✔ Accept	0.03035496	0.76161212	0.88123087
DRRELAREA -> PARTN	0.110226548	✔ Accept	0.02716784	0.05855898	0.16280222
DRRELAREA -> IAM	-0.004360232	✖ Reject	0.01345758	-0.03017231	0.02249059
STRATOR -> PARTN	0.489419400	✔ Accept	0.02022612	0.44922179	0.52881057
STRATOR -> IAM	0.165960548	✔ Accept	0.02936689	0.10140028	0.21714170
INVAREA -> IAM	0.004324685	✖ Reject	0.01513741	-0.02491957	0.03445651
PARTN -> IAM	0.006174280	✖ Reject	0.01326522	-0.02001736	0.03116870

```
model_pls1.final$inner_model
```

```
## $PARTN
##                Estimate Std. Error       t value      Pr(>|t|)
## Intercept -7.675465e-15 0.01874053 -4.095650e-13  1.000000e+00
## DRRELAREA  1.102265e-01 0.02088898  5.276779e+00  1.457524e-07
## STRATOR    4.894194e-01 0.02088898  2.342954e+01 1.920697e-107
## 
## $IAM
##                Estimate  Std. Error       t value       Pr(>|t|)
## Intercept -2.125679e-15 0.008782745 -2.420289e-13  1.000000e+00
## ASSES     -1.453413e-01 0.009674446 -1.502321e+01  2.095766e-48
## QUAL       8.154419e-01 0.023757831  3.432308e+01 3.266939e-203
## DRRELAREA -5.040801e-03 0.010282927 -4.902107e-01  6.240388e-01
## STRATOR    1.629387e-01 0.021703335  7.507544e+00  9.036221e-14
## INVAREA    4.324685e-03 0.012158653  3.556879e-01  7.221120e-01
## PARTN      6.174280e-03 0.010658194  5.792989e-01  5.624530e-01
```

The Final Equation

Equantion 1:
$PARTN = -7.675465e-15 * (0.3041415 * DRRELAREA1 + 0.2997206 * DRRELAREA2 - 0.3844680 * DRRELAREA4 + 0.2900736 * DRRELAREA5) + 4.894194e-01 * STRATOR2.$
Equation 1 simplified:
$PARTN = -2.334427e-15 * DRRELAREA1 - 2.300495e-15 * DRRELAREA2 - 2.950971e-15 * DRRELAREA4 - 2.22645e-15 * DRRELAREA5 + 4.894194e-01 * STRATOR2.$
PLS-PM Equation
IAM: $2.125679e \quad 15 \quad 1.453413e \quad 01 * (0.5693484 * ASSES1 + 0.3354102 + 0.3015996 * ASSES3) \quad 8.154419e \quad 01 * QUAL1 \quad 5.040801e \quad 03 * (0.3041415 * DRRELAREA1 + 0.2997206 * DRRELAREA2 + 0.3844680 * DRRELAREA4 \quad 0.2900736 * DRRELAREA5) + 1.629387e \quad 01 * STRATOR2 +$
Combining both of the equations:
$2.125679e \quad 15 \quad 1.453413e \quad 01 * (0.5693484 * ASSES1 + 0.3354102 * ASSES2 + 0.3015996 * ASSES3) + 8.154419e \quad 01 * QUAL1 \quad 5.040801e \quad 03 * (0.3041415 * DRRELAREA1 + 0.2997206 * DRRELAREA2 + 0.3844680 * DRRELAREA4 + 0.2900736 * DRRELAREA5) + 1.629387e \quad 01 * STRAT$
Simplifying 1:
$2.125679e \quad 15 \quad 0.08274984 * ASSES1 \quad 0.04874895 * ASSES2 \quad 0.04383488 * ASSES3 + 8.154419e \quad 01 * QUAL1 \quad 0.001533117 * DRRELAREA1 \quad 0.001510832 * DRRELAREA2 \quad 0.001938027 * DRRELAREA4 \quad 0.001462203 * DRRELAREA5 \quad 1.629387e \quad 01 * STRATOR2 + 4.324685e \quad 03 *$
Simplifying 2:
$IAM = -2.125679e-15 - 0.08274982 * ASSES1 - 0.04874894 * ASSES2 - 0.04383486 * ASSES3 + 0.8154419 * QUAL1 - 0.001533117 * DRRELAREA1 - 0.001510832 * DRRELAREA2 - 0.001938027 * DRRELAREA4 - 0.001462203 * DRRELAREA5 + 0.1629387 * STRATOR2 - 0.004324685 * INV$

```
#ASSES:
model_pls1.final$inner_model$IAM[c(2),1]*model_pls1.final$outer_model$weight[c(1,2,3)]
```

```
## [1] -0.08274982 -0.04874894 -0.04383486
```

```
# QUAL
model_pls1.final$inner_model$IAM[c(3),1]*model_pls1.final$outer_model$weight[c(4)]
```

```
## [1] 0.8154419
```

```
#DRRELAREA
model_pls1.final$inner_model$IAM[c(4),1]*model_pls1.final$outer_model$weight[c(5,6,7,8)]
```

```
## [1] -0.001533117 -0.001510832 -0.001938027 -0.001462203
```

```
#STRATOR
model_pls1.final$inner_model$IAM[c(5),1]*model_pls1.final$outer_model$weight[c(9)]
```

```
## [1] 0.1629387
```

```
#INVAREA
model_pls1.final$inner_model$IAM[c(6),1]*model_pls1.final$outer_model$weight[c(10)]
```

```
## [1] 0.004324685
```

```
ASSES<-table %>%
  select(ASSES1, ASSES2, ASSES3)*model_pls1.final$inner_model$IAM[c(2),1]*model_pls1.final$outer_model$weight[c(1,
2,3)]
ASSES<-ASSES%>%
  rowwise() %>%
    mutate(
        ASSES = sum(c_across(ASSES1:ASSES3))
    )%>%
  select(ASSES)
```

```
QUAL<-table %>%
  select(QUAL1)*model_pls1.final$inner_model$IAM[c(2),1]*model_pls1.final$inner_model$IAM[c(3),1]*model_pls1.fina
l$outer_model$weight[c(4)]
DRRELAREA<-table %>%
  select(DRRELAREA1,DRRELAREA2,DRRELAREA4,DRRELAREA5)*model_pls1.final$inner_model$IAM[c(2),1]*model_pls1.final$in
ner_model$IAM[c(4),1]*model_pls1.final$outer_model$weight[c(5,6,7,8)]
DRRELAREA<-DRRELAREA%>%
  rowwise() %>%
    mutate(
        DRRELAREA = sum(c_across(DRRELAREA1:DRRELAREA5))
    )%>%
  select(DRRELAREA)
STRATOR<-table %>%
  select(STRATOR2)*model_pls1.final$inner_model$IAM[c(2),1]*model_pls1.final$inner_model$IAM[c(5),1]*model_pls1.fi
nal$outer_model$weight[c(9)]
INVAREA<-table %>%
  select(INVAREA1)*model_pls1.final$inner_model$IAM[c(2),1]*model_pls1.final$inner_model$IAM[c(6),1]*model_pls1.fi
nal$outer_model$weight[c(10)]
```

Prediction of IAM

```
IAM<-ASSES+QUAL+DRRELAREA+STRATOR+INVAREA
colnames(IAM)<-"IAM"
```