test1_versione2

June 29, 2020

#Clone directory

[1]:
```
!git clone https://github.com/pm-lab-polito/pm_networks
```

```
Cloning into 'pm_networks'…
remote: Enumerating objects: 23, done.
remote: Counting objects: 100% (23/23), done.
remote: Compressing objects: 100% (14/14), done.
remote: Total 23 (delta 8), reused 22 (delta 7), pack-reused 0
Unpacking objects: 100% (23/23), done.
```

[2]:
```
import networkx as nx
import matplotlib.pyplot as plt
import pandas as pd
from networkx import community
import community as community_louvain
```

#Importa i networks

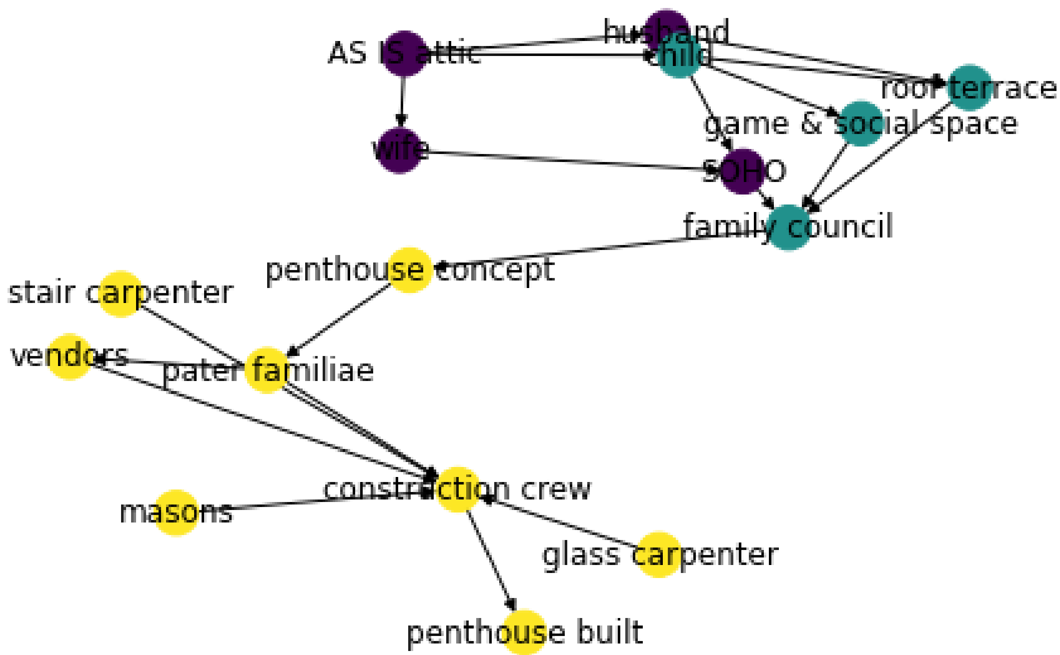
[3]:
```
G0 = nx.read_gml('pm_networks/graphml/penthouse_00.gml')
G1 = nx.read_gml('pm_networks/graphml/penthouse_01.gml')
G2 = nx.read_gml('pm_networks/graphml/penthouse_02.gml')
list_net = [G0,G1,G2]
```

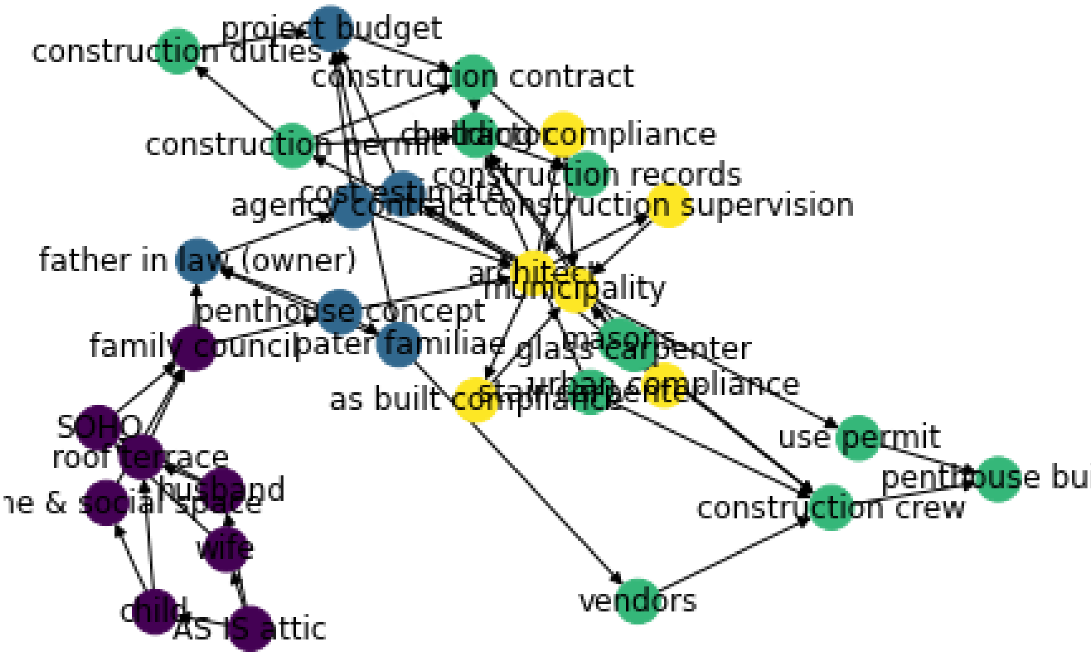
1 Creiamo le comunità con l'algoritmo python louvain (massimizza la modularità delle comunità)

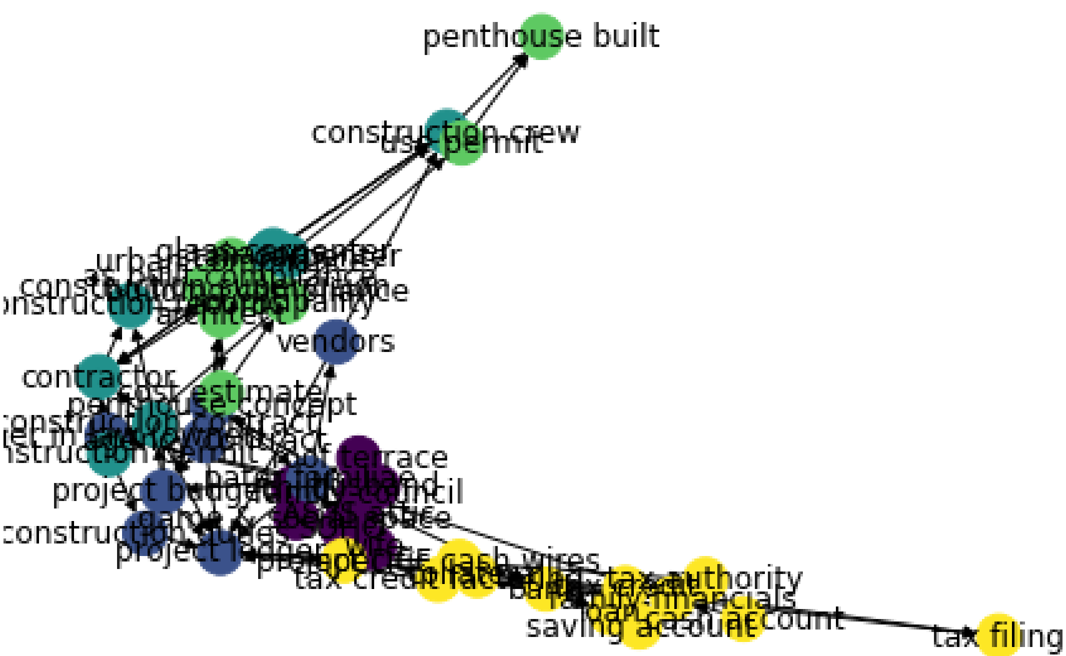
[4]:
```
#le communities del louvain funzionano su undirected networks, quindi le␣
↪trasformiamo in undirected momentaneamente
H0 = G0.to_undirected()
partition0 = community_louvain.best_partition(H0)
H1 = G1.to_undirected()
partition1 = community_louvain.best_partition(H1)
H2 = G2.to_undirected()
partition2 = community_louvain.best_partition(H2)
lista_partizioni =[partition0 ,partition1,partition2]
```

#Plotta i networks con i colori che corrispondono alla community

[5]:
```
for i in range (len(list_net)):
  nx.draw(list_net[i], node_color = list(lista_partizioni[i].values()),␣
 ↪with_labels=True)
  plt.show()
```




project budget
construction duties
construction contract
construction permit
construction records
cost estimate
agency contract
construction supervision
father in law (owner)
municipality
penthouse concept
family council
pater familiae
masons
glass carpenter
urban compliance
as built compliance
use permit
construction crew
SOHO
roof terrace
husband
wife
child
AS IS attic
vendors


penthouse built
construction crew
use permit
vendors
contractor
cost estimate
penthouse concept
roof terrace
project budget
tax authority
family financials
saving account
tax filing

#Calcola le metriche del network

[6]:
```
list_density = []
list_SH_path = []
list_node_conn = []
list_node_trans = []
```

[7]:
```
for i in list_net:
  Den = nx.density(i)
  sh = nx.average_shortest_path_length(i)
  conn = nx.average_node_connectivity(i)
  #trans = nx.transitivity(1) # only for undirected
  list_density.append(Den)
  list_SH_path.append(sh)
  list_node_conn.append(conn)
  #list_node_trans.append(trans)
```

[8]:
```
report = pd.DataFrame(list_density, columns=['Density'])
report['Shortest_path'] = list_SH_path
report['Node_conn']= list_node_conn
```

[9]:
```
report
```

[9]:

	Density	Shortest_path	Node_conn
0	0.083333	0.895833	0.337500
1	0.053427	1.940524	0.549395
2	0.040909	1.625253	0.447980

[10]:
```
report_delta = report/report.shift(1)-1
```

[11]:
```
report_delta
```

[11]:

	Density	Shortest_path	Node_conn
0	NaN	NaN	NaN
1	-0.358871	1.166167	0.627838
2	-0.234305	-0.162467	-0.184595

2 Calcola le metriche relative ai singoli nodi (per ora degree e betweness centrality)

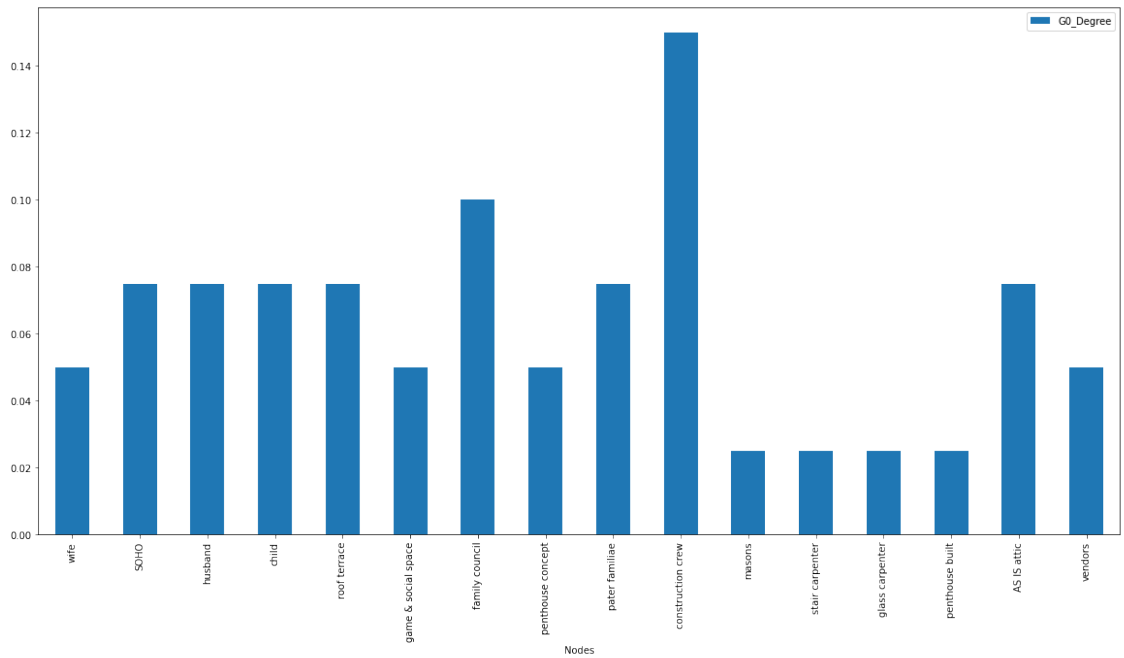
Degree

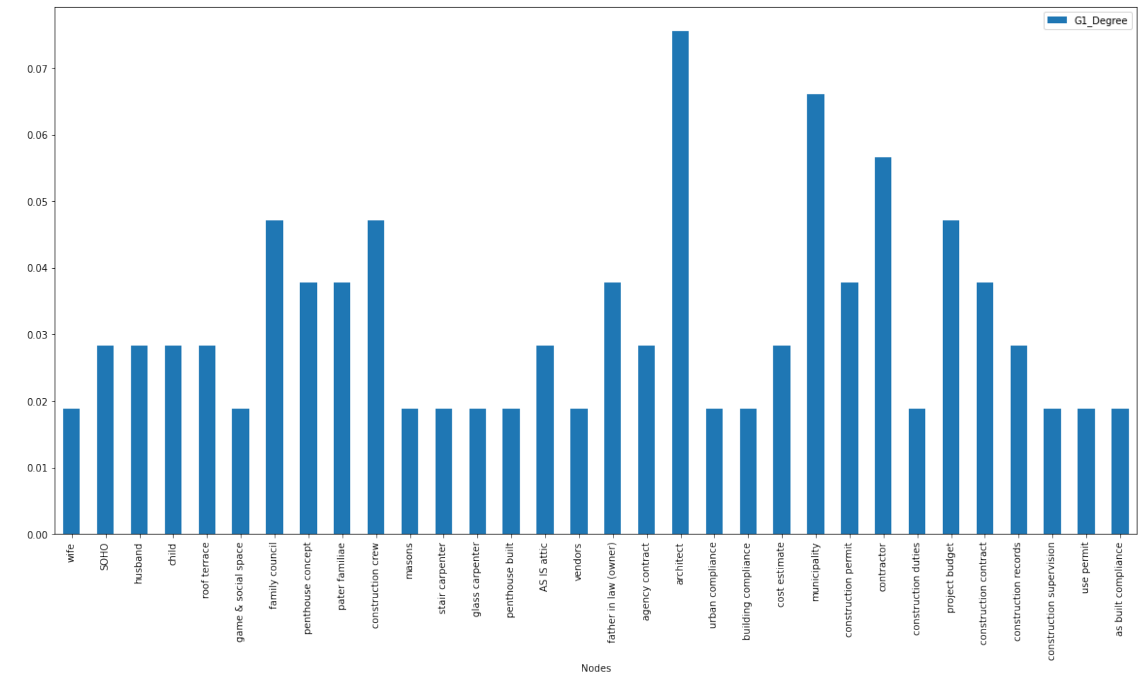
[12]:
```
# calcoliamo la degree per ogni nodo
list_metr_nodes_degree = []
A = 0
for i in list_net:
```

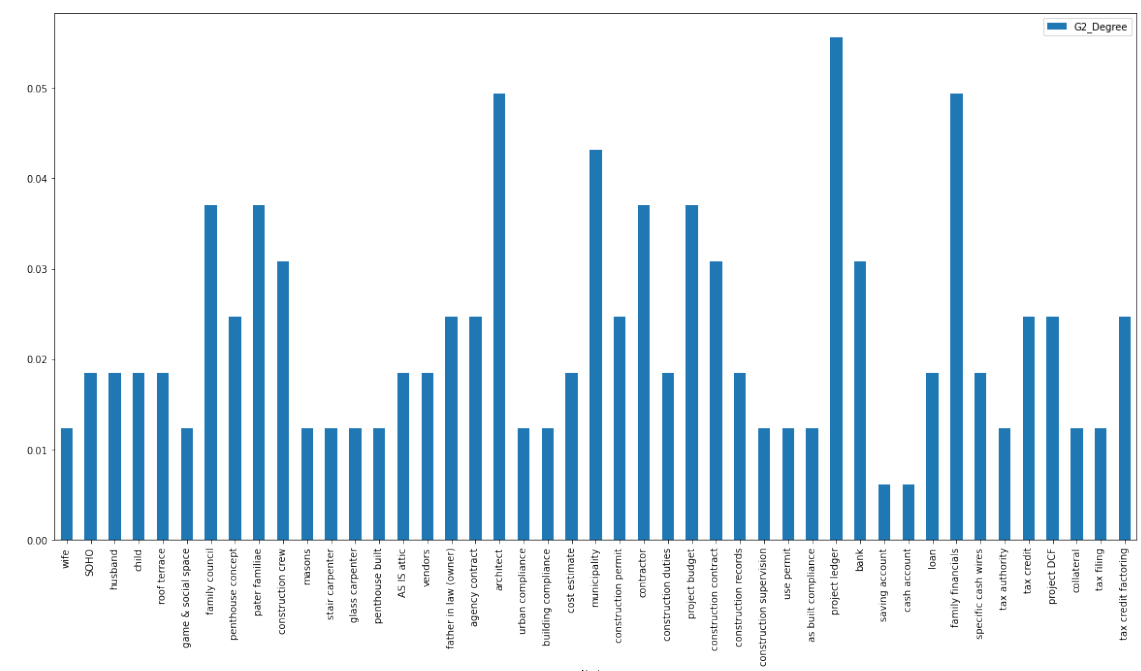
```
  colonna = ("G"+str(A)+"_Degree")
  nodi = pd.DataFrame()
  nodi = pd.DataFrame((nx.degree(i)), columns = ['Nodes', colonna])
  nodi = nodi.set_index(['Nodes'], drop=True)
  nodi[colonna]=nodi[colonna]/nodi[colonna].sum() #normalizziamo il grado

  list_metr_nodes_degree.append(nodi)
  A = A+1
```

a

[13]:
```
#plottiamo la degree dei singoli nodi
for i in range (3):
  list_metr_nodes_degree[i].plot(kind='bar',figsize=(20,10))
```

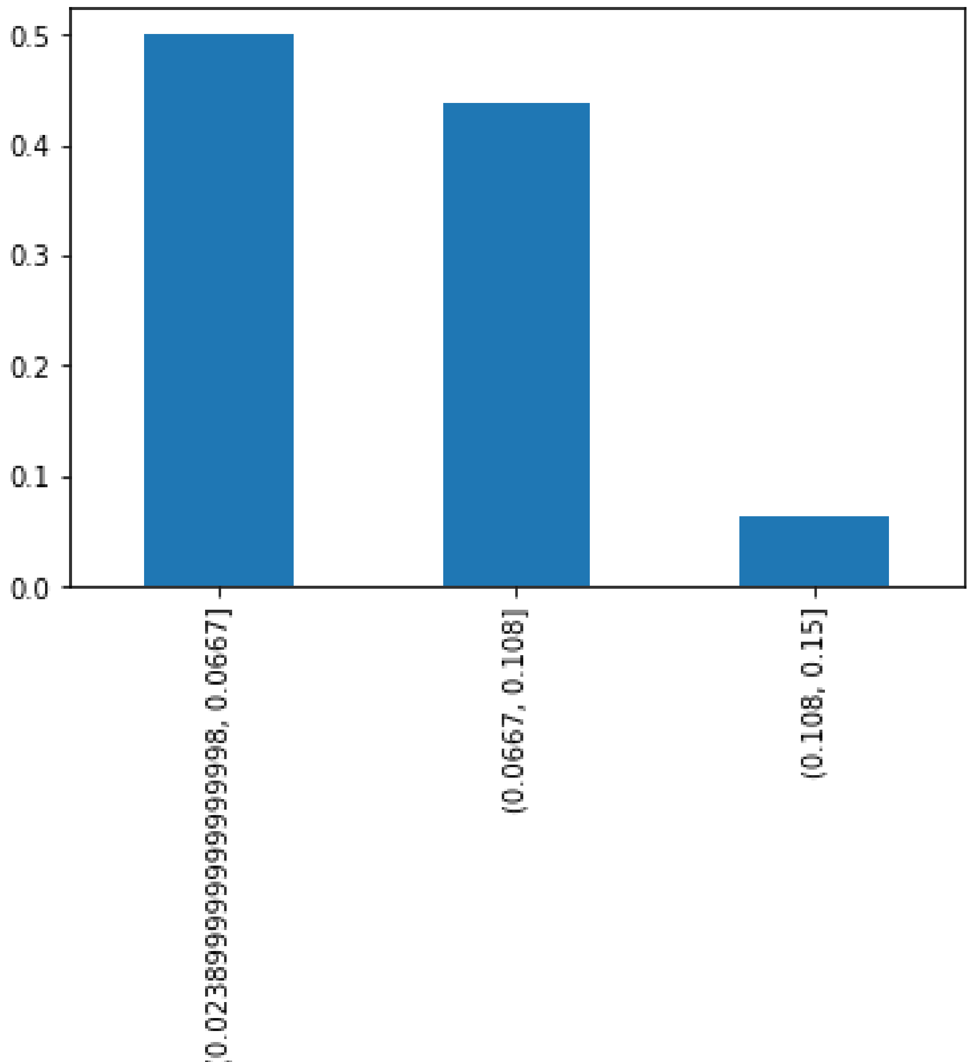


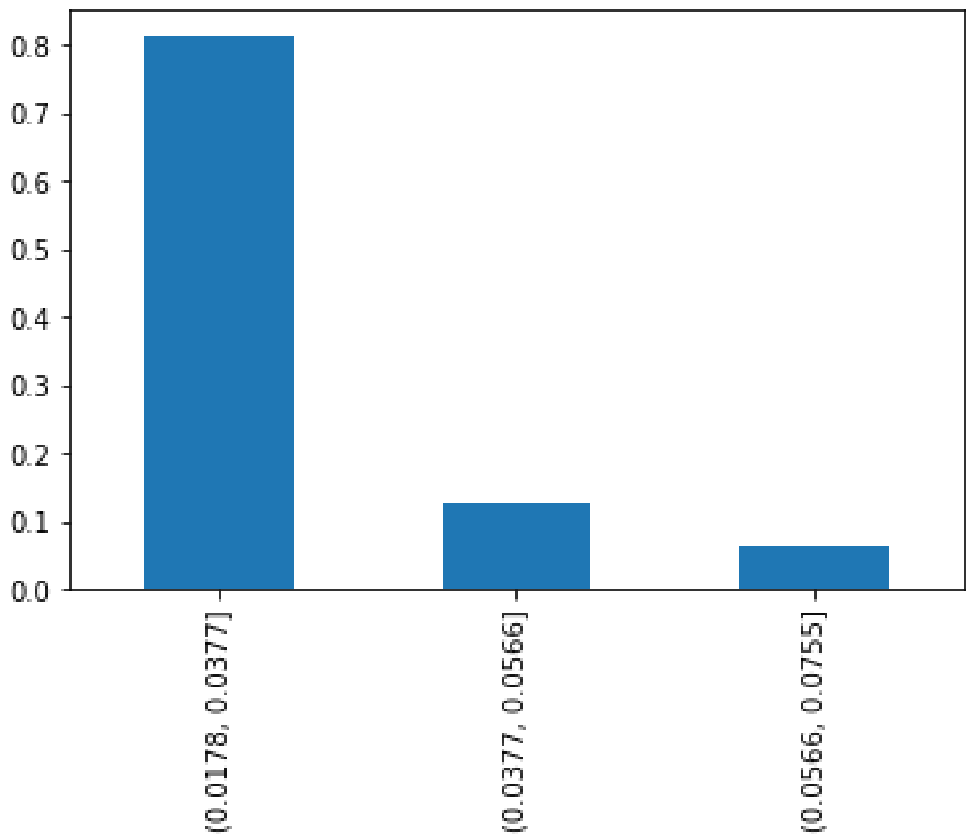


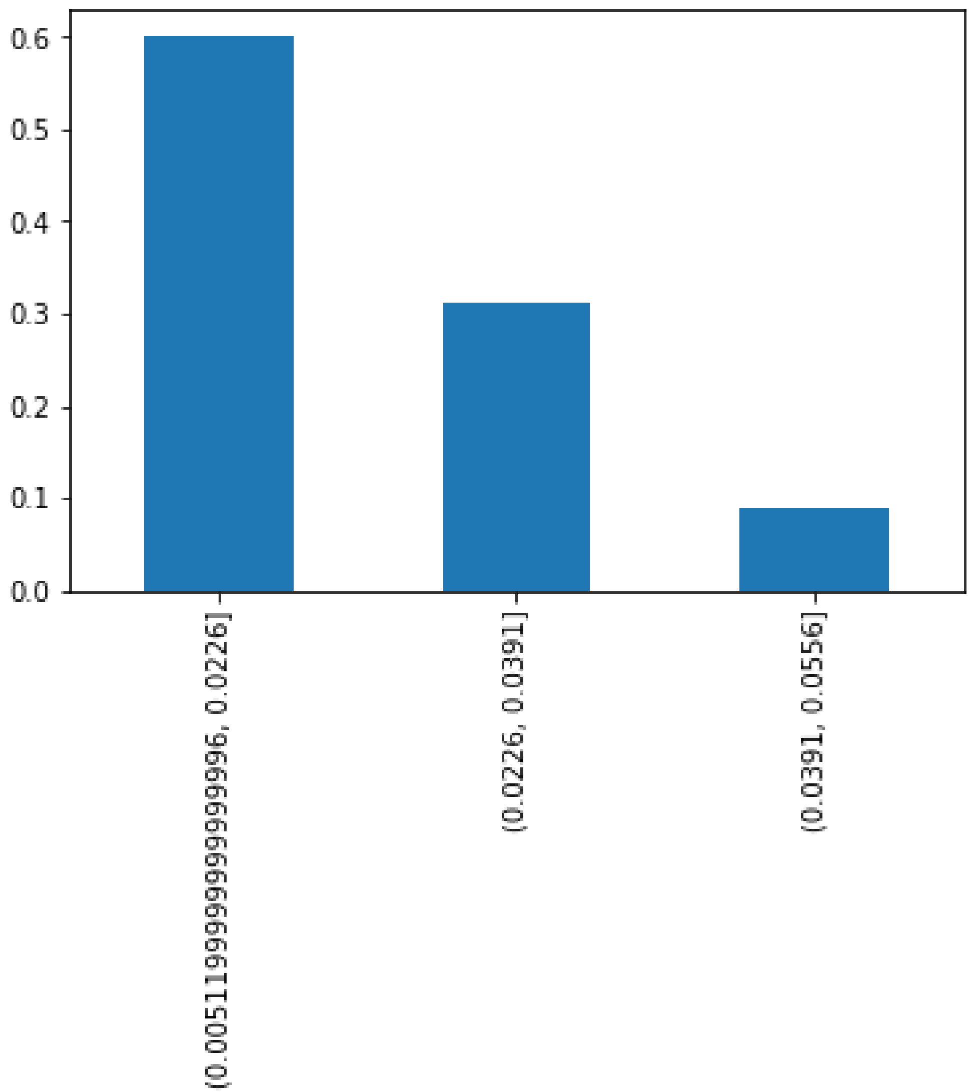


Plottiamo la distribuzione normalizzata della degree

[14]:
```
#plottiamo la distribuzione normalizzata con istogrammi

for i in range (3):
  colonna = ("G"+str(i)+"_Degree")
  list_metr_nodes_degree[i][colonna].value_counts(normalize = True, bins = 3).
↪plot(kind='bar')
  plt.show()
```



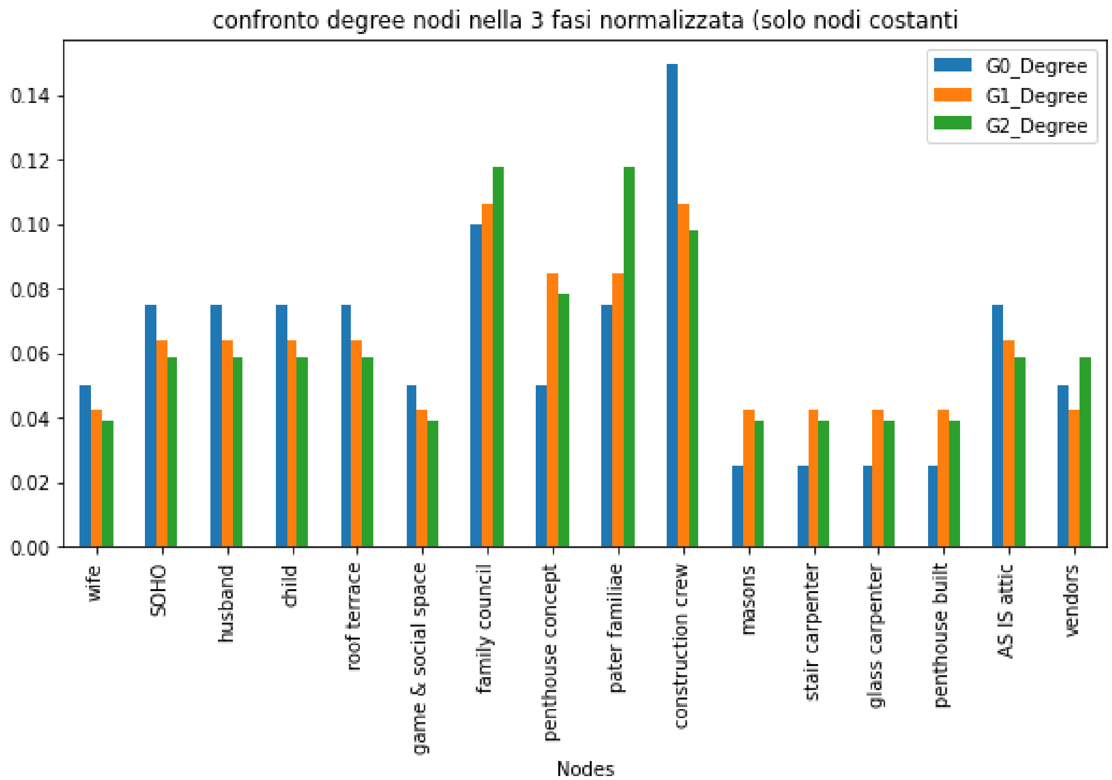

0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
(0.0178, 0.0377]
(0.0377, 0.0566]
(0.0566, 0.0755]



Confrontiamo la degree dei nodi PERMANENTI nelle 3 fasi del progetto

[15]:
```
#uniamo i DF per vedere come cambia la degree del nodo nelle tre fasi
mappa_degree = list_metr_nodes_degree[0]
for i in range (1,3):

  mappa_degree = mappa_degree.join(list_metr_nodes_degree[i])

mappa_degree = mappa_degree/mappa_degree.sum()


mappa_degree.plot(kind='bar', figsize=(10,5))
plt.title("confronto degree nodi nella 3 fasi normalizzata (solo nodi costanti")
```

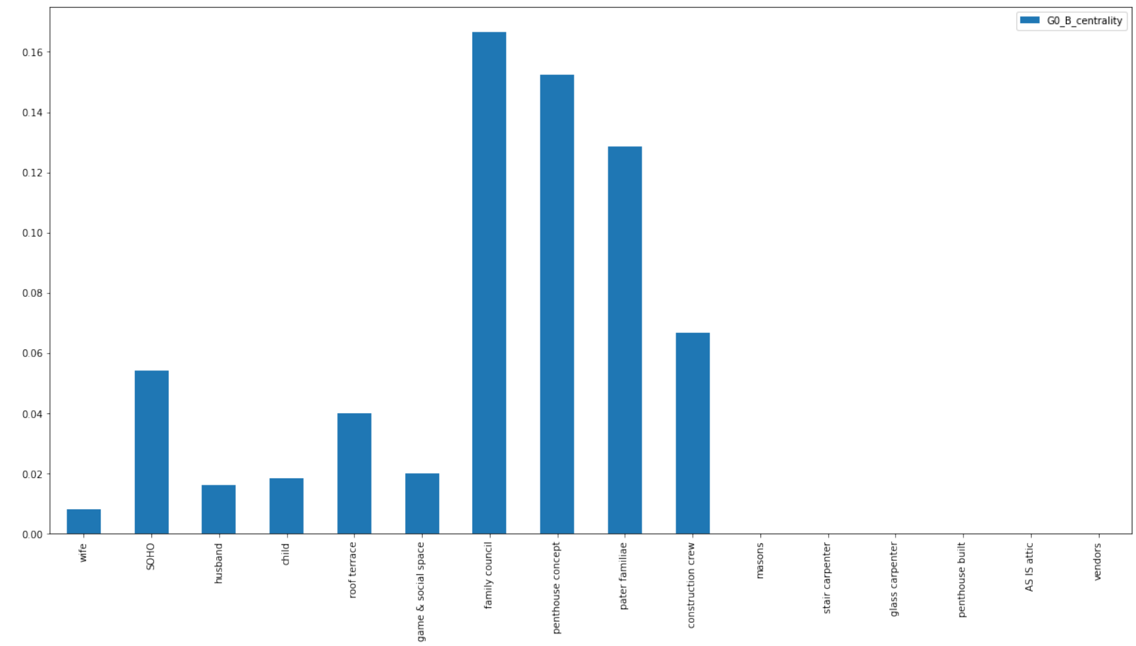
[15]: Text(0.5, 1.0, 'confronto degree nodi nella 3 fasi normalizzata (solo nodi costanti')



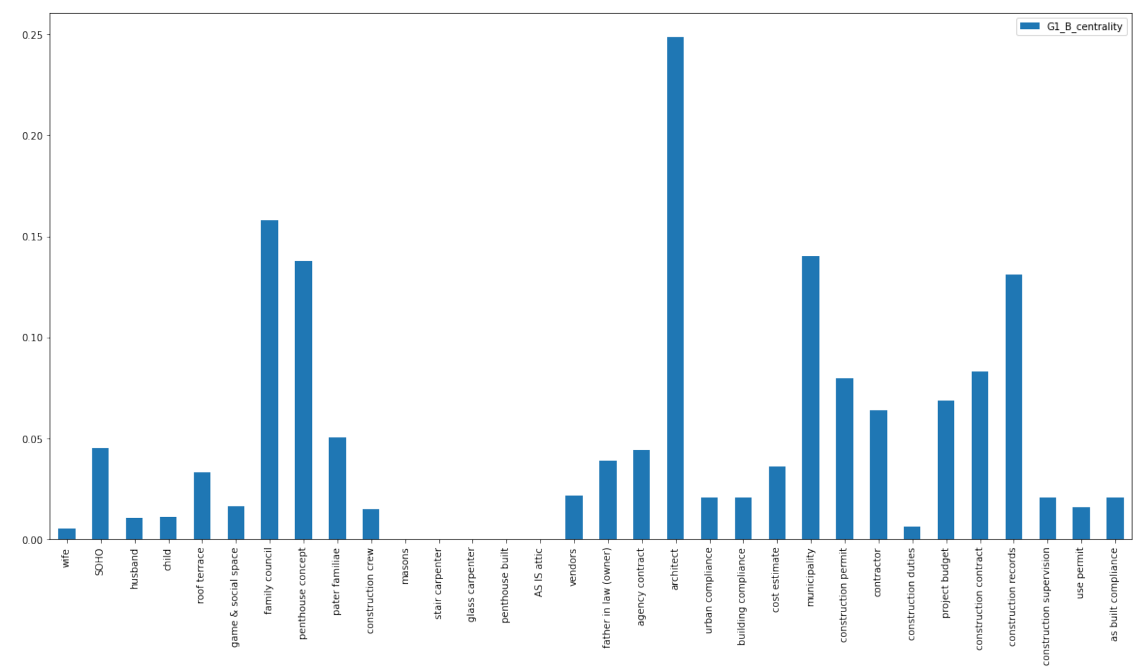
Centrality

[16]:
```
# calcoliamo la centraility per ogni nodo
list_metr_nodes_centrality = []
A = 0
for i in list_net:

  colonna = ("G"+str(A)+"_B_centrality")
  nodi = pd.DataFrame(nx.betweenness_centrality(i).values(), index= nx.
↪betweenness_centrality(i).keys(), columns=[colonna])
  list_metr_nodes_centrality.append(nodi)
  A = A+1
```

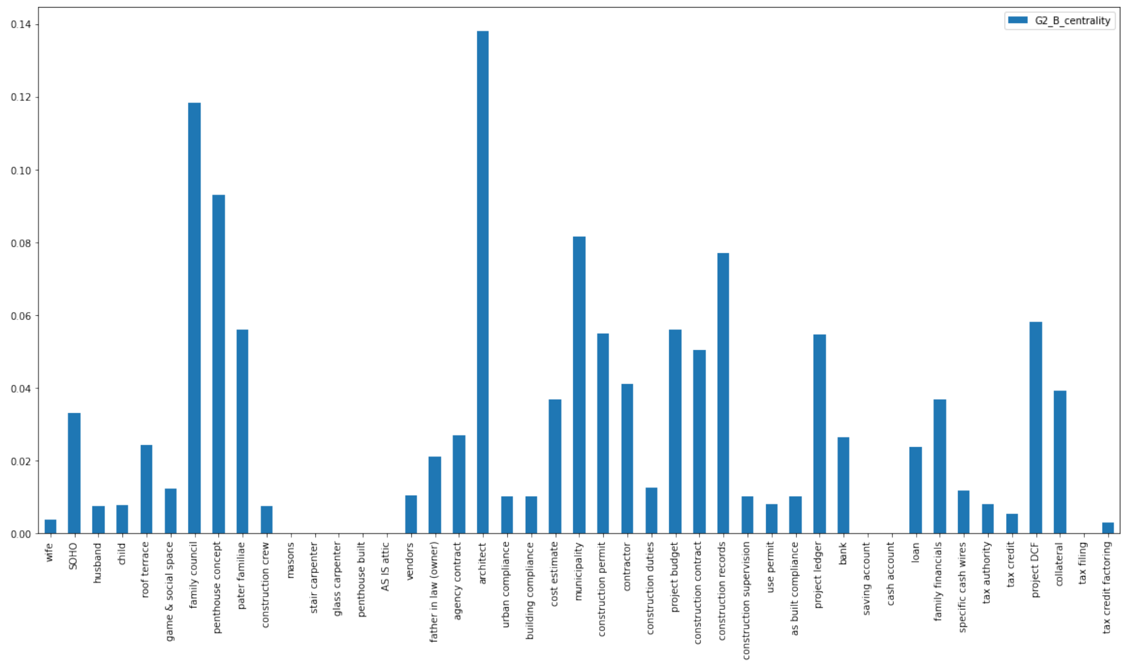
[17]:
```
#plottiamo la centrality dei singoli nodi
for i in range (3):
  list_metr_nodes_centrality[i].plot(kind='bar',figsize=(20,10))
```



G0_B_centrality
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
wife
SOHO
husband
child
roof terrace
game & social space
family council
penthouse concept
pater familiae
construction crew
masons
stair carpenter
glass carpenter
penthouse built
AS IS attic
vendors

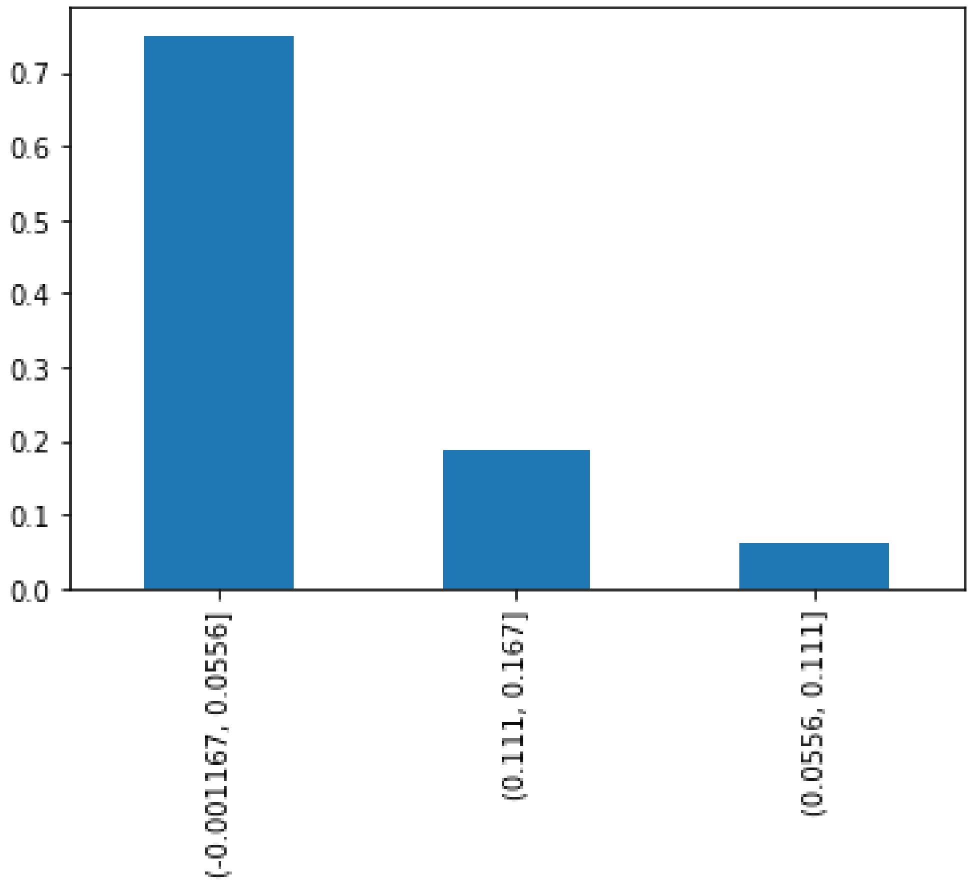


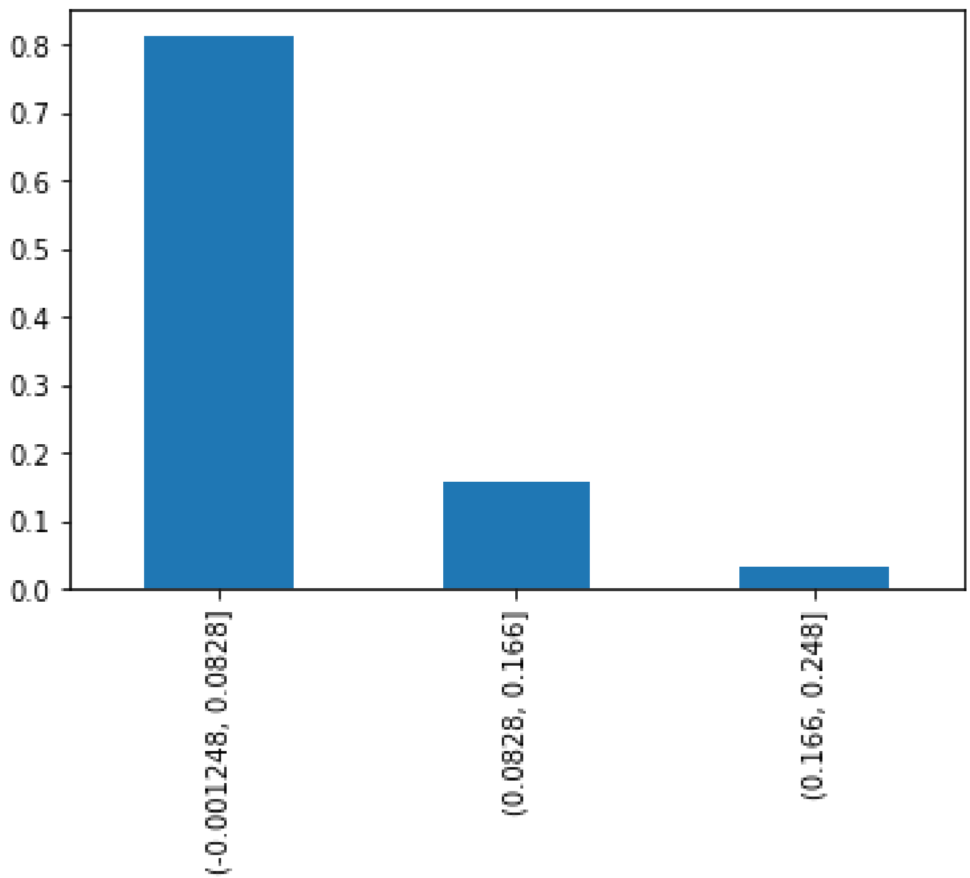
G1_B_centrality
0.00
0.05
0.10
0.15
0.20
0.25
wife
SOHO
husband
child
roof terrace
game & social space
family council
penthouse concept
pater familiae
construction crew
masons
stair carpenter
glass carpenter
penthouse built
AS IS attic
vendors
father in law (owner)
agency contract
architect
urban compliance
building compliance
cost estimate
municipality
construction permit
contractor
construction duties
project budget
construction contract
construction records
construction supervision
use permit
as built compliance

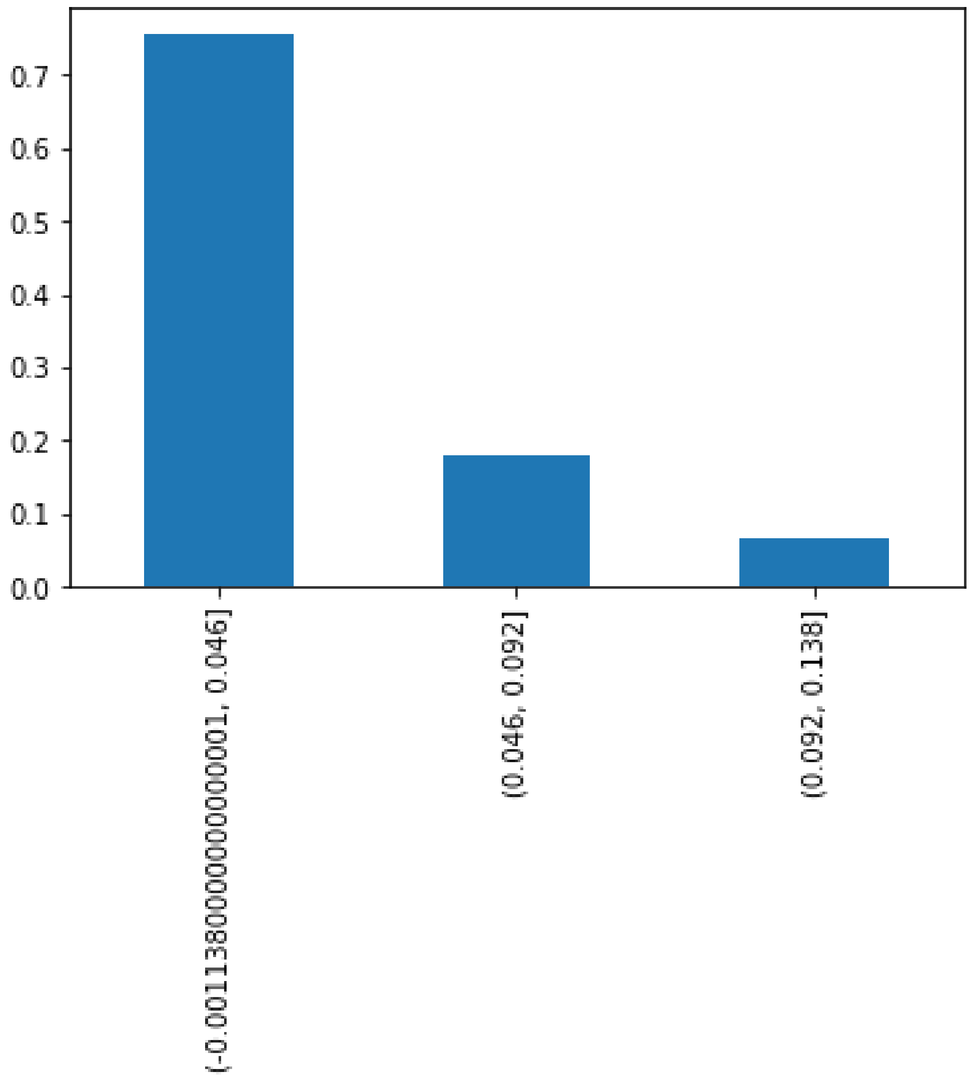


Plottiamo la distribuzione normalizzata della Centrality

[18]:
```
#plottiamo la distribuzione normalizzata con istogrammi
for i in range (3):
  colonna = ("G"+str(i)+"_B_centrality")
  list_metr_nodes_centrality[i][colonna].value_counts(normalize = True, bins =
 ↪3).plot(kind='bar')
  plt.show()
```


0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
(-0.001167, 0.0556]
(0.111, 0.167]
(0.0556, 0.111]

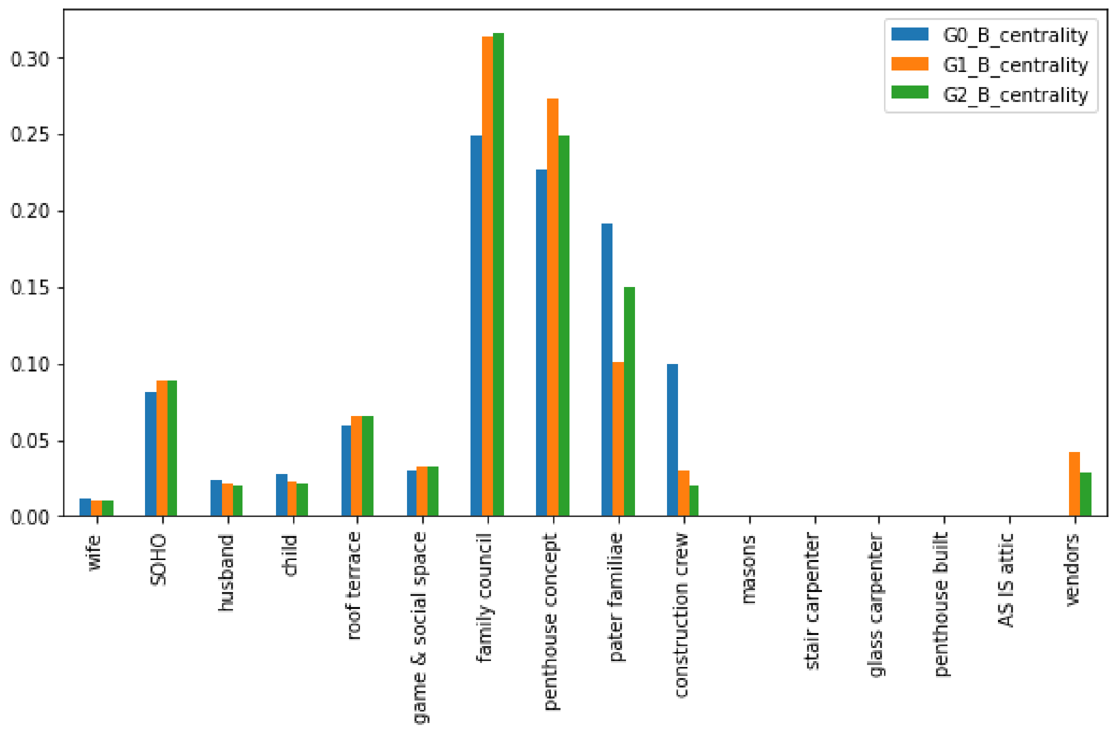

0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
(-0.001248, 0.0828]
(0.0828, 0.166]
(0.166, 0.248]

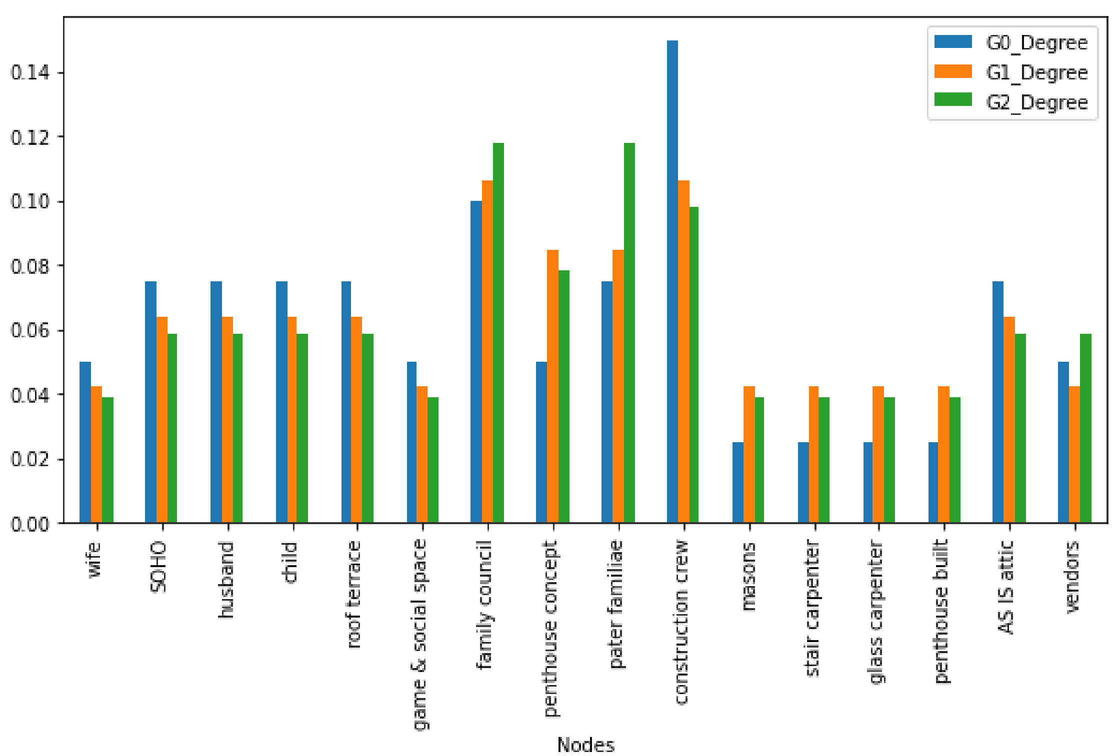


Confrontiamo la centrality dei nodi PERMANENTI nelle 3 fasi del progetto

[19]:
```
#uniamo i DF per vedere come cambia la centralità del nodo nelle tre fasi
mappa_centrality = list_metr_nodes_centrality[0]
for i in range (1,3):
  mappa_centrality = mappa_centrality.join(list_metr_nodes_centrality[i])

mappa_centrality = mappa_centrality/mappa_centrality.sum()

mappa_centrality.plot(kind='bar', figsize = (10,5))
mappa_degree.plot(kind='bar', figsize=(10,5))
```

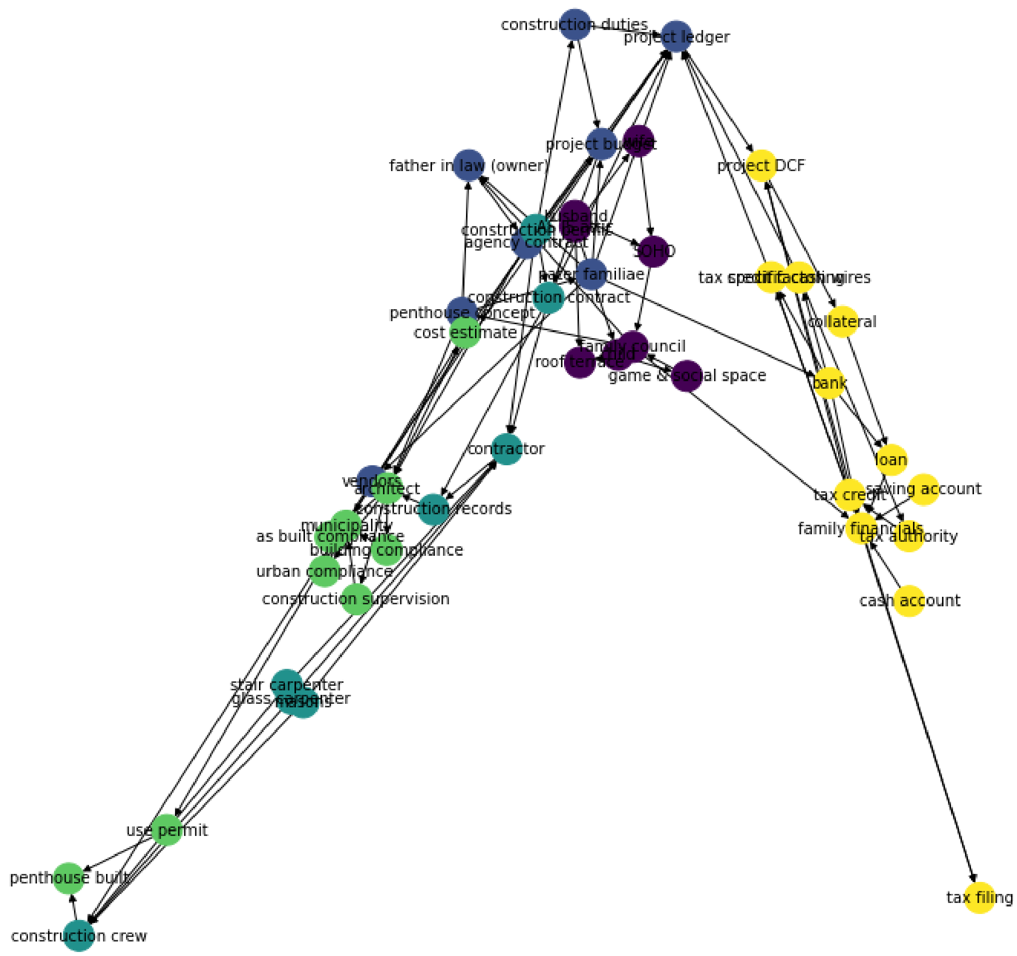
[19]: <matplotlib.axes._subplots.AxesSubplot at 0x7fd739c9afd0>


G0_B_centrality
G1_B_centrality
G2_B_centrality
0.00
0.05
0.10
0.15
0.20
0.25
0.30
wife
SOHO
husband
child
roof terrace
game & social space
family council
penthouse concept
pater familiae
construction crew
masons
stair carpenter
glass carpenter
penthouse built
AS IS attic
vendors


G0_Degree
G1_Degree
G2_Degree
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
wife
SOHO
husband
child
roof terrace
game & social space
family council
penthouse concept
pater familiae
construction crew
masons
stair carpenter
glass carpenter
penthouse built
AS IS attic
vendors
Nodes

#disegna più grande per leggibilità

[20]:
```
plt.figure(figsize=(10,10))
nx.draw(G2, node_color = list(lista_partizioni[2].values()), with_labels=True,␣
↪font_size=10, node_size=400)
```



[20]:
```

```