

Network Science

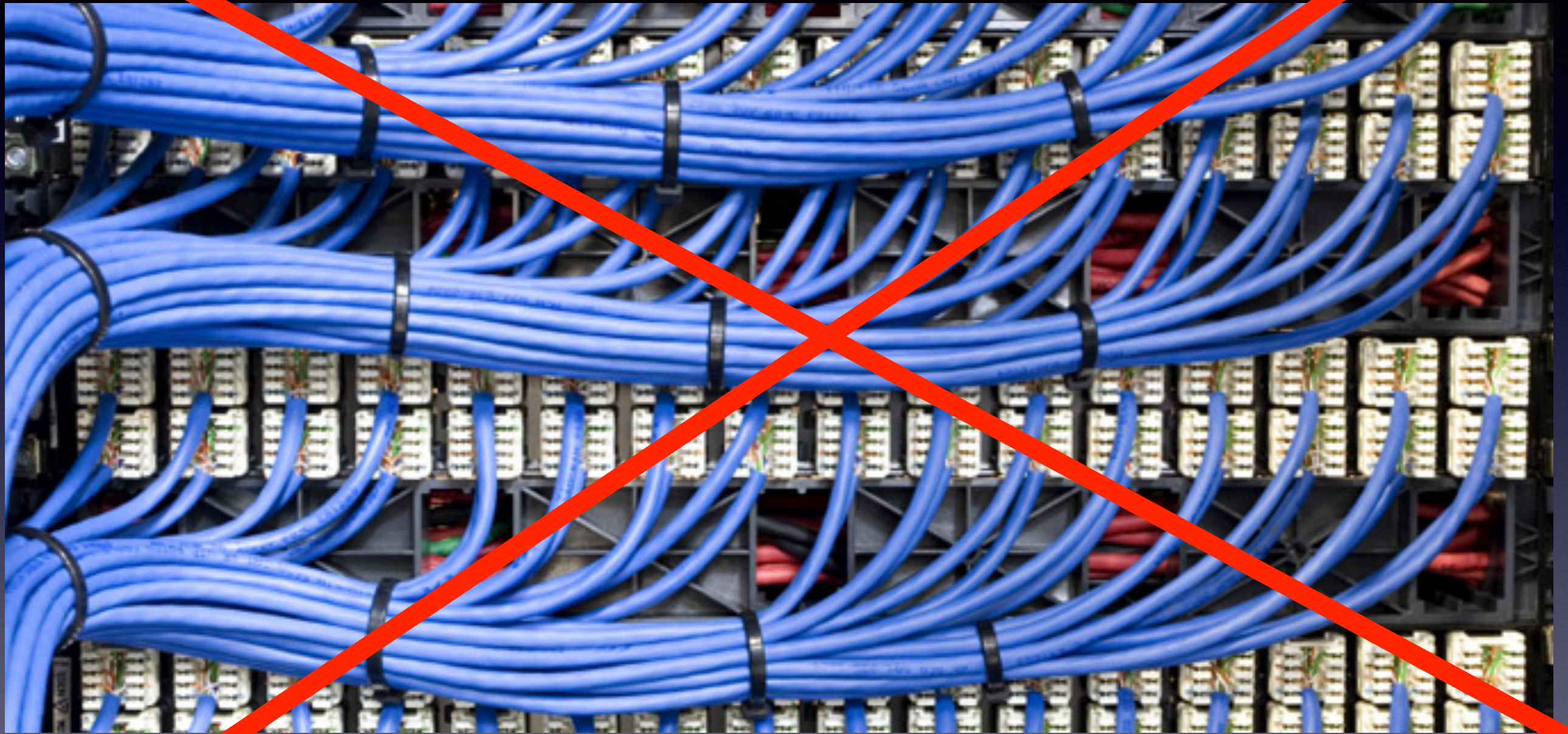
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Network Science investigates non-trivial features of graph problems that usually are not addressed by lattice theory or random graphs

A popular subfield of
Network Science is **Social
Network Analysis**

The foundation of
Network Science is made
out of **graph theory**

a **node** = a person

a **link** = presence of relation
between two people

1736

Leonhard Euler

Seven Bridges of Koenigsberg

1959

Paul Erdos & Alfred Renyi
On random graphs

1967

Stanley Milgram

The small world phenomenon

In *average* there are just 6 people
(friend of friend) between each of
us and every other human on this
planet

On **Facebook** the average distance between two users is about **4.7**

1973

Mark Granovetter

The strength of weak ties

A weak tie

=

Friend that has **no other friends in common** with you

The majority of people
get hired with the aid of
weak ties

In large graphs clusters
are connected through
weak ties

In the absence of weak
ties graphs would not be
connected

1980

Computing power
became affordable

1990

WWW

1995

Detailed map making in
biology and physics

1998

Barabasi & Albert
Scale free networks

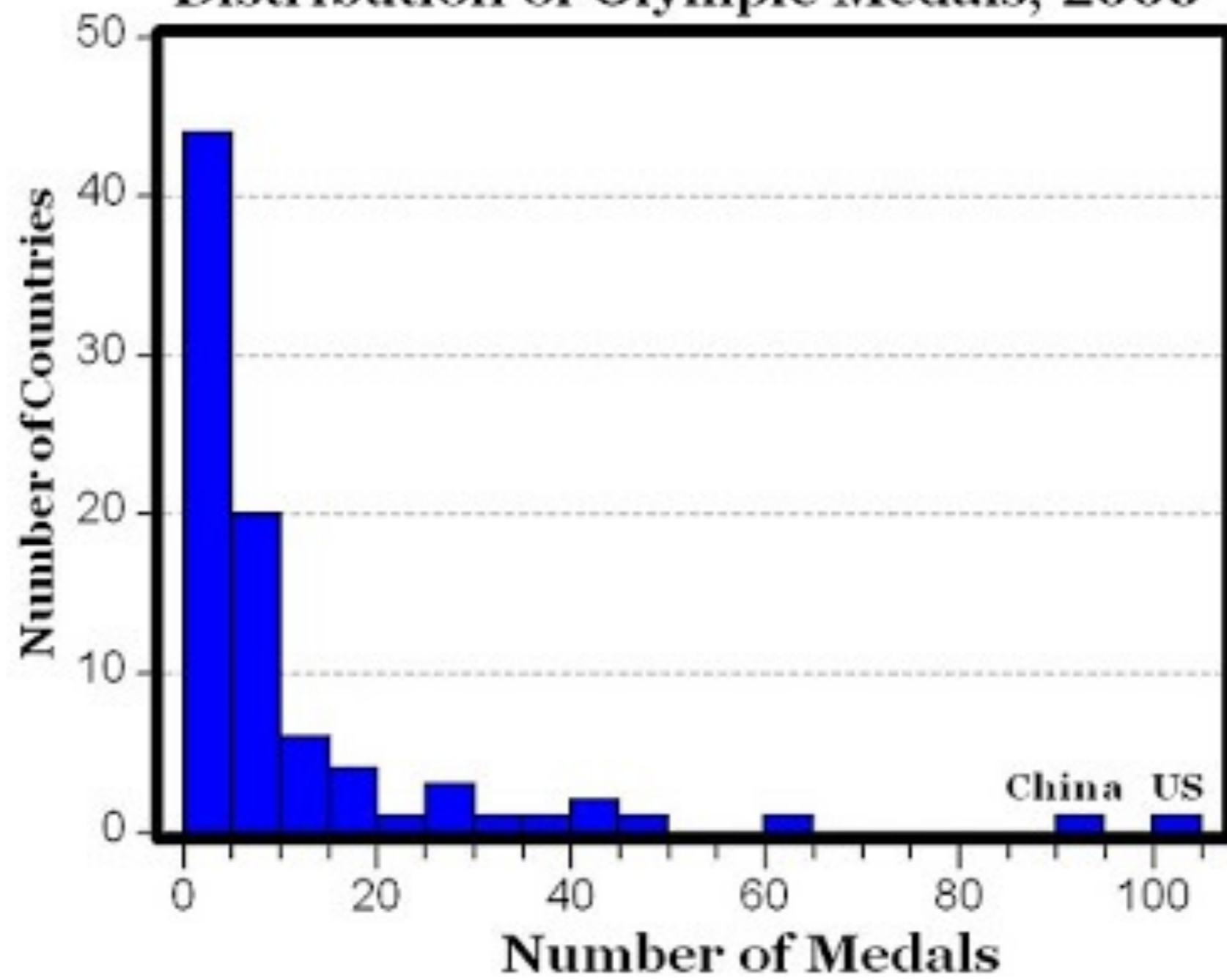
number of friends = node **degree**
the **distribution** of degree is of
Pareto/Zipf type

Degree



Nodes

Distribution of Olympic Medals, 2008



Homophily

The tendency of people that are alike to bond together

Preferential attachment

People have a tendency to make friends that have a lot of friends
(are popular)

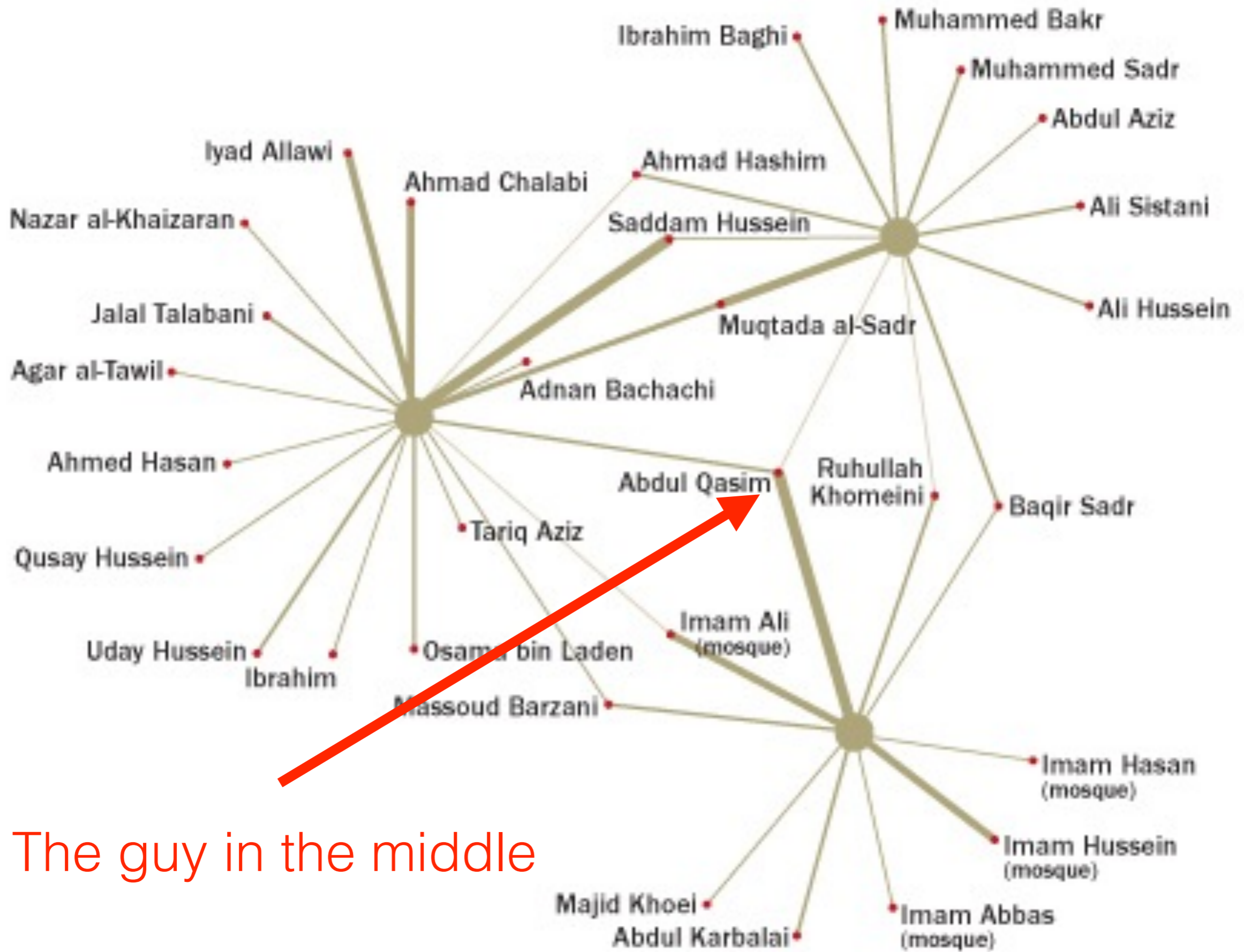
Applications of Network Science

Prevention of diseases spread

Security

Discovering ways to
reach terrorist/dictators

Saddam Hussein was
caught with the help of
Network Science



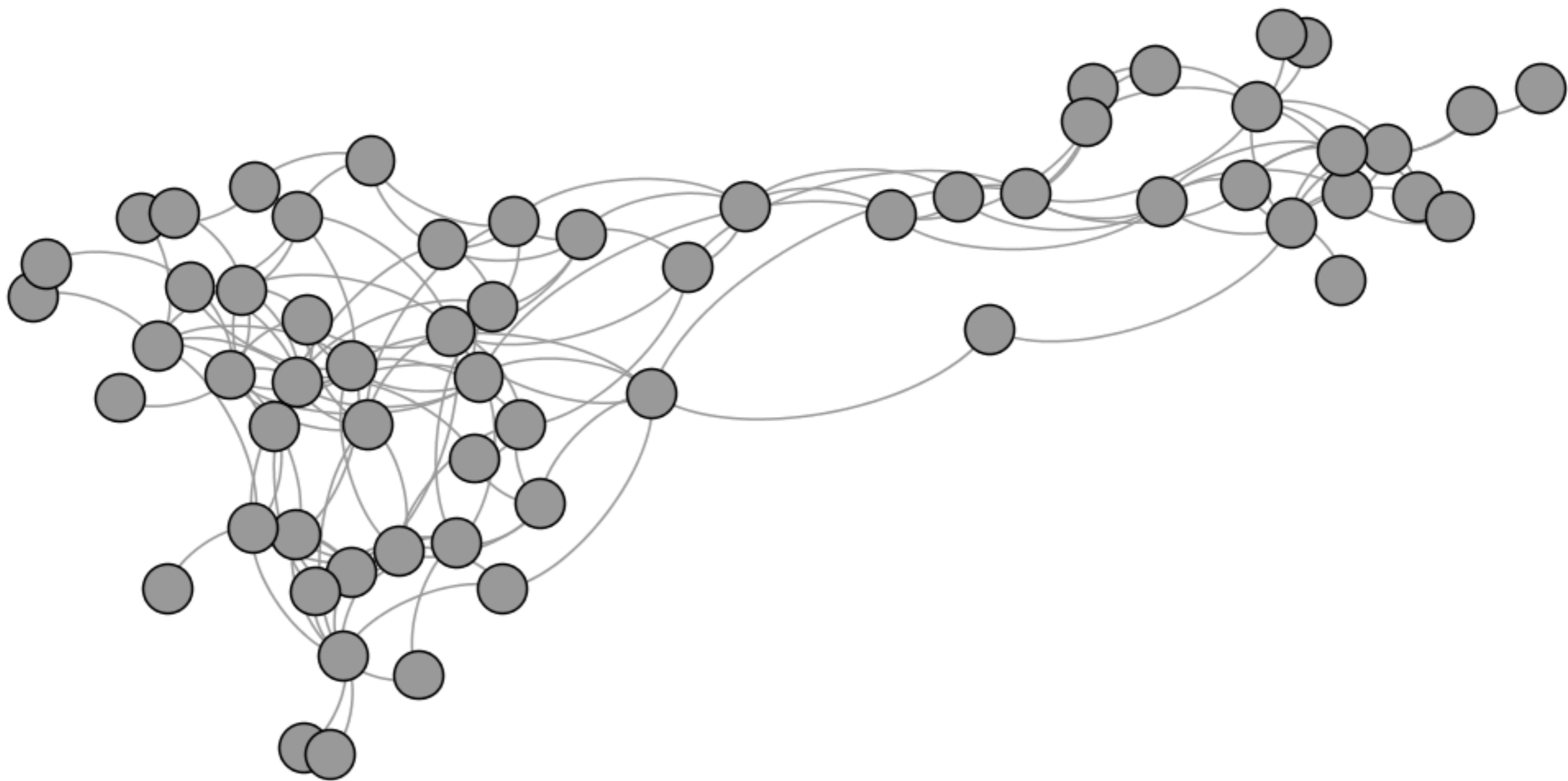
The guy in the middle

Help establish good
working environments for
companies

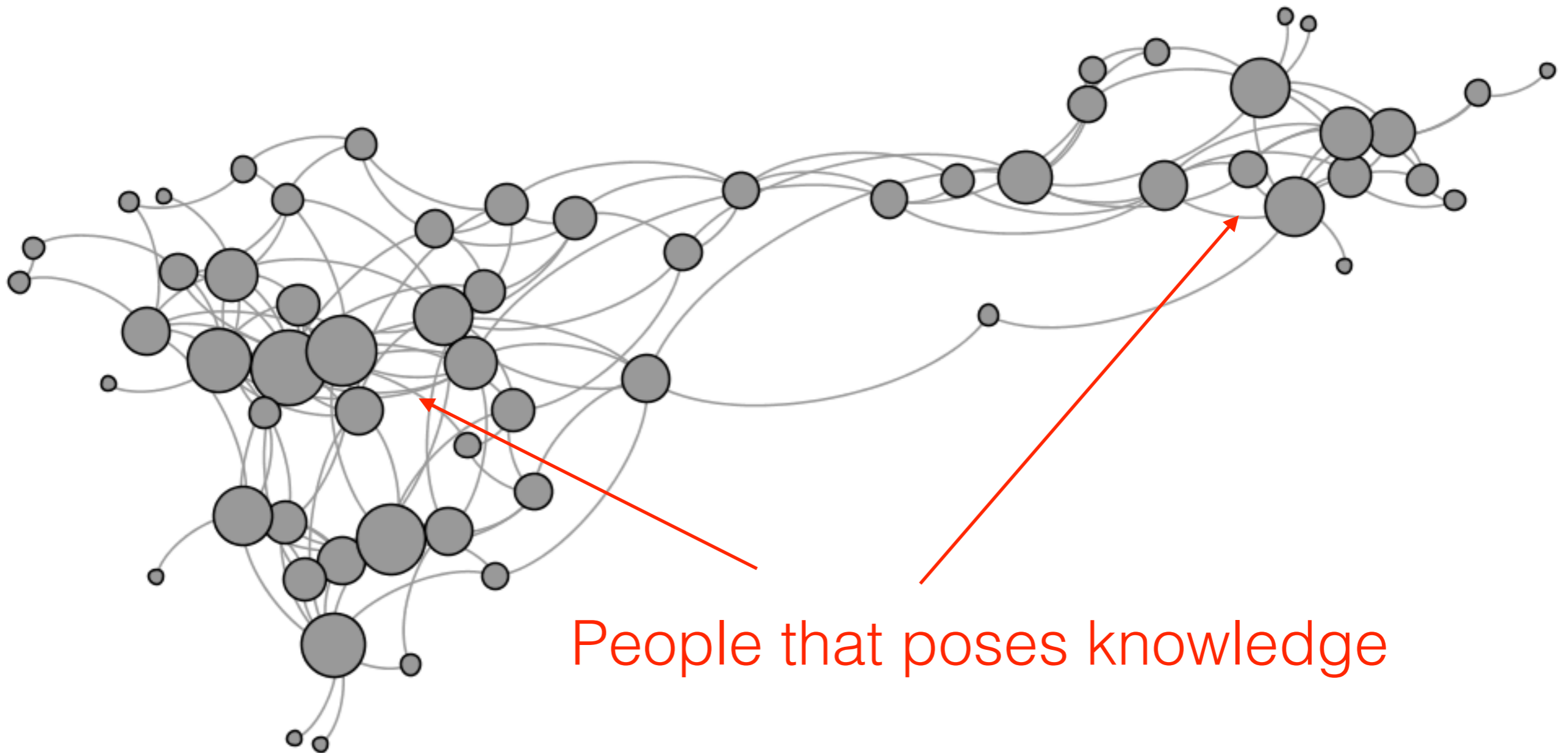
Organisational Network Analysis
(ONA) is the science that studies
the formal or informal networks
that appear within an organisation

Let us analyse the flow of
information into a
company

A **link** between two nodes
represents the a relation
of **knowledge exchange**



Node size proportional with the number of connections

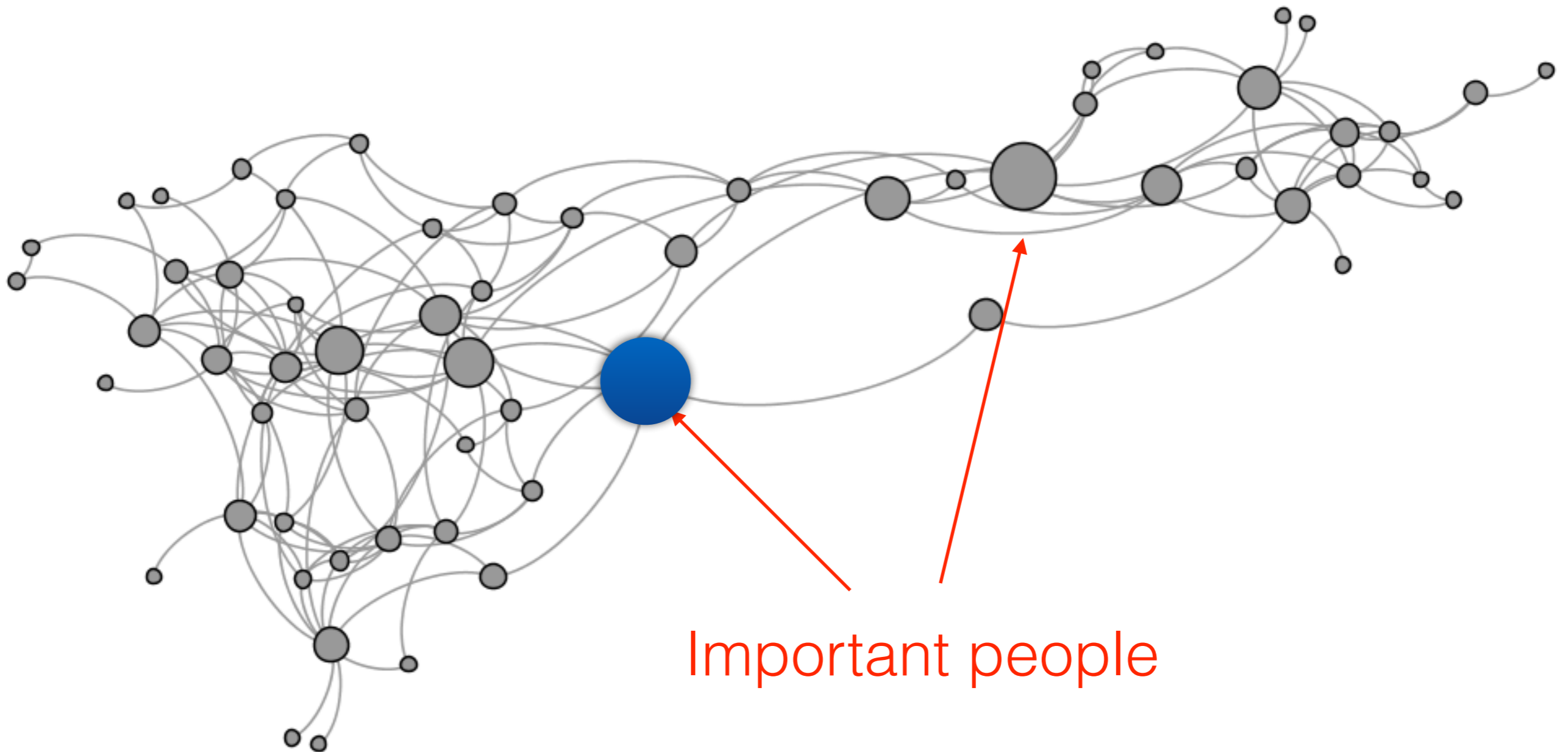


Betweenness = Who controls the flow of information

When information travels through a network, it takes the most convenient path possible (shortest path).

Betweenness centrality measures the number of shortest paths in which the user is in the sequence of nodes in the path.

Node size is proportional to betweenness centrality



Scenario

The companies merge
into a bigger one

How do you help in
creating a combined
social environment?

Create graphs where the
links state **who eats with**
who during lunch breaks?

Thus we determine the
social clusters

In each cluster we
determine the most
popular employee

During next month the
most social guys are put
at the same eating table

Organisational Network Analysis

- **Create** graphs / networks
- **Analise** graphs
- **Interpret** results

Network Science helps in
determining important
nodes in different scenarios

Suggestions



Questions

Problems

Looking forward to study
to work together with
anyone interested