SWARMING NOTES
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Typical Properties of Swarms

- Many individual
- Relatively homogenous – yet diverse in perspectives
- Interactions are based on simple rules that exploit or use local information
- Overall behaviors – results from interaction of individuals - self-organizing, local interaction = global Behavior

Animals Systems

Ants colonize
Birds flock
Fish School
Animals herd
Bees swarm

The wonderful appeal of swarm intelligence. Whether we're talking about ants, bees, pigeons, or caribou, the ingredients of smart group behavior—decentralized control, response to local cues, simple rules of thumb—add up to a shrewd strategy to cope with complexity.

Such thoughts underline an important truth about collective intelligence: Crowds tend to be wise only if individual members act responsibly and make their own decisions. A group won't be smart if its members imitate one another, slavishly follow fads, or wait for someone to tell them what to do. When a group is being intelligent, whether it's made up of ants or attorneys, it relies on its members to do their own part. For those of us who sometimes wonder if it's really worth recycling that extra bottle to lighten our impact on the planet, the bottom line is that our actions matter, even if we don't see how.

How Swarm Intelligence Works: simple creatures following simple rules each one acting on local information. No ant sees the big picture. No ant tells any other ant what to do. Some ant species may go about this with more sophistication than others. But the bottom line no leadership is required - Even complex behavior may be coordinated by relatively simple interactions

BEES
- seek a diversity of options, identify all the possibilities
- encourage a free competition among ideas, kick their ideas around for a while,
- use an effective mechanism to narrow choices, vote by secret ballot

"It's exactly what the swarm bees do, which gives a group time to let the best ideas emerge
and win. People are usually quite amenable to that."

- members are diverse,
- independent minded, and
- use a mechanism such as voting, auctioning, or averaging to reach a collective decision.

**BIRDS** - birds don't have a leader. No pigeon is telling the others what to do. Instead, they're each paying close attention to the pigeons next to them, each bird following simple rules as they wheel across the sky. These rules add up to another kind of swarm intelligence—one that has less to do with making decisions than with precisely coordinating movement.

Basic flocking is controlled by three simple rules:

- **Separation** - avoid crowding neighbours (short range repulsion)
- **Alignment** – fly in average directions or heading of nearby bird
- **Cohesion** - steer towards average position of neighbours or stay close to nearby bird (long range attraction)

With these three simple rules, the flock moves in an extremely realistic way, creating complex motion and interaction that would be extremely hard to create otherwise.

It's much harder for a predator to avoid being spotted by a thousand fish than it is to avoid being spotted by one. News that a predator is approaching spreads quickly through a school because fish sense from their neighbors that something's going on."

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**FISH** - When a predator strikes a school of fish, the group is capable of scattering in patterns that make it almost impossible to track any individual.

- It might explode in a flash,
- create a kind of moving bubble around the predator,
- or fracture into multiple blobs, before coming back together and swimming away.

**Elements of a Wise Crowd**

These key criteria separate wise crowds from irrational ones:

- **Diversity of Opinion** - Each person should have private information even if it's just an eccentric interpretation of the known facts.
- **Independence** - People's opinions aren't determined by the opinions of those around them.
- **Decentralization** - People are able to specialize and draw on local knowledge.
- **Aggregation** - Some mechanism exists for turning private judgments into a collective decision.

**Failures of crowd intelligence**
• **Too homogeneous** – you need to have diversity within a crowd to ensure enough variance in approach, thought process, and private information.
• **Too centralized** – only a few people know what is going on
• **Too divided** – one part is not talking to another
• **Too imitative** – people don’t think things through themselves but just copy others.
• **Too emotional** – emotional factors, such as a feeling of belonging, can lead to peer pressure, herd instinct and in some collective hysteria.