

# Reducing Incentives for Agent Collaboration

## (Position Paper)

Neil Yorke-Smith<sup>1,2</sup>

<sup>1</sup> Olayan School of Business, American University of Beirut, Lebanon.

<sup>2</sup> SRI International, Menlo Park, CA, USA.

`nysmith@aub.edu.lb`

**Abstract.** The benefits of collaborative agents include achievement of complex goals that are difficult or impossible to attain for an individual agent. Incentive schemes, market mechanisms, and organizational structures can be designed to foster collaboration. On the other hand, unwanted collaboration between small numbers of agents, at the expense of the benefit to the greater society, demands measures to disincentivize such negative, collusive collaboration.

## 1 Why Collaboration is Not Always Desirable

In an ideal world, cooperative agents work together to achieve greater goals for the good of the larger society. This ideal is not the world we live in. Self-interested agents act for their own selfish benefit at the expenses of others; groups of self-interested agents collude for their benefit at the expense of the larger society. Collaborators break their promises, fail to comply with norms or regulations, and even straight-out deceive. Agents can be at best careless and at worst treacherous.

Just as incentive schemes, market mechanisms, and organizational structures can be designed to foster collaboration, we argue that some situations require careful design of anti-collaboration provisions.

Now famous is the 1995 US FCC spectrum auction [1]. The rules of the auction prohibited companies from openly colluding to divide the spectrum at low cost to themselves and hence low value for the public. The major players in the auction neatly circumvented the rules, however, by using the least significant digits of their public messages to coordinate their bidding strategies. “In other words, these parties used the auction protocol itself to cheat” [15].

Electoral voting machines have been another headline topic for agents collaborating in anti-social manners [14]. How can the public have confidence that their vote will be properly recorded and accounted, and that fallacious votes will not be accounted? Supposing there is an inspection, what if certain agents (such as the machine manufacturers) collude with the inspection agents?

This position paper draws attention to the need to disincentivize such negative, collusive collaboration, and to otherwise mitigate their effects.

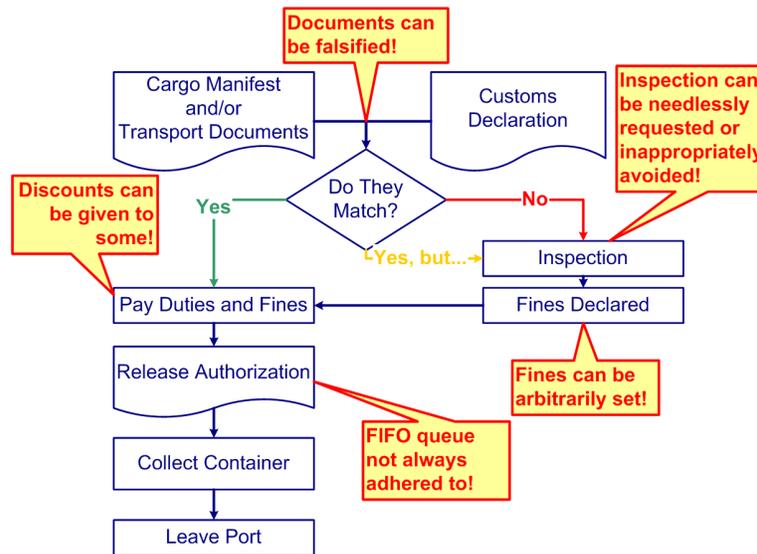
Appeared at: AAMAS’11 Workshop on Collaborative Agents — Research and Development, Taipei, Taiwan, May 2011.

## 2 Example: Maritime Customs Collaboration

Ocean-based freight, according to the International Maritime Organization, account for 90 percent of world trade by weight [12]. The inspection of container contents and application of regulations and tariffs is a significant part of the import-export process at ports worldwide. The progress of containers through customs, however, is more often an exercise in negotiation rather than a structured queuing process. As soon as such a regulatory process involves negotiation, corruption in its various manifestations becomes a possibility.

Fig. 1 shows some possible deviations from an archetypal customs import process. These include inaccurate, incomplete, or fictitious documentation; under- or over-inspection; inaccurate value estimation; waiving true fines or imposing additional fines; and delaying or expediting certain containers. In some situations, a whole grey ‘parallel customs’ system evolves.

Extra-process negotiation is the most common entry point for non-standard behaviour within customs processes [11]. Agents willingly or unwillingly make private, collusive agreements. Such non-standard practices fall into three categories [16, 7]. First, deviations based on the relationship between agents, where there is no obvious monetary or physical bribe. Relationship levers in negotiation can arise from family connection (nepotism), political tie (patronage), or favour owed. Second, deviations be based on monetary considerations, where there is a tangible bribe, whether cash or gift, or a debt forgiven. Third, negotiation levers based on threats or extortion, whether physical, financial, or reputation-based.



**Fig. 1.** An archetypal import process. Some opportunities for deviations from the published process are highlighted.

The Organization for Economic Co-operation and Development (OECD) notes, particularly for developing countries, that customs revenue is a significant component of public finances, but that customs efficiency is often hampered by widespread corruption, creating “a major disincentive and obstacle to trade expansion” and leading to “disastrous consequences in terms of national security and public finance” [8].

The effect of corruption burden communities and nations, weighing especially on the disenfranchised. It hinders development, being “one of the most serious barriers to overcoming poverty”, with a strong correlation manifest between perceived corruption and national per capita income [18].

### 3 Disincentives, Incentives, and Process Design

Given that corruption can enter a market or process whenever there is opportunity for agents to negotiate, what can be done to reduce the opportunities and the incentives for and the impact of collusive behaviour? In certain situations, guaranteed collusion-free protocols can be deployed (see Shelat [15] for a brief overview). When it is not possible to eliminate negative collaboration entirely,<sup>3</sup> how can the system be made more robust to its presence?

A perfusion of legal or normative rules provide no guarantee of disincentivizing collusion. As Tacitus observed, “The more corrupt the state, the more laws.” Studies by the OECD and other organizations report that customs corruption is not easily combated by policy changes, for example [8]. Further, extended processes can provide more opportunities for negotiation and hence foster rather than disincentivize deviations from the ideal.<sup>4</sup>

Hence a call can be issued to re-examine the research on agent collaboration and market design [6]. The call is to disincentivize the socially bad behaviours, not just incentivize socially good behaviours. It is not enough to be able to check correctness of published contracts [2]; nor can we assume agents are cooperative.

**Catalysts and culture.** The problem of collusion is, then, challenging for those who would wish to tackle it. Collusion can arise from within a group of agents, needing no external catalyst agent. It can be fostered, however, by the existence of external mediating agents, such as ‘fixers’ in a customs process. Dignum et al. [4] point to the interaction of many elements—economic, social, personal, structural, environmental—as determining the existence and role of mediator agents. Further, the broad socio-cultural environment shapes agent behaviour in negotiation [3]. Hence relevant is study of organizational behaviour, norm emergence, and societal culture (for a computational study of culture’s influence on human-agent negotiation, see Gal et al. [5]).

---

<sup>3</sup> In the case of customs, such an effort would be prohibitively expensive and unrealistic. Further, draconian efforts can have adverse implications for personal freedoms and fundamental human rights.

<sup>4</sup> “Systems and procedures [evolve] to maximise the number of steps and approvals—to create as many opportunities as possible for negotiation” [8].

**Protocols and decision aids.** If we take ‘agents’ to refer to autonomous entities, encompassing human actors and businesses as well as automated agents, then the failed Covisint business-to-business market in the automotive industry [13] is another demonstration of the problems of cooperation—besides that of collusion—that can emerge in an auction setting.

Karlsson et al. [10] show how positive cooperation (among humans) can be incentivized through market-based protocols that allow complex bids.<sup>5</sup> While such protocols have theoretical and computational advantages, behavioural economics assures us that humans are not rational decision-makers. Decision aids may be needed in order for complex market-based protocols to be effective.

**Mechanism design and simulation.** Spectrum auction markets is one domain where collusion-resistant market mechanisms have been developed [19], motivated by the FCC experience; another is online reputation mechanisms [9]. How do these mechanisms transfer to more ill-defined processes and agent systems such as in the domain of customs? How can elusive notions such as ‘benefit to society’ be quantified, and taken into algorithmic account?

The connection to the agents community arises naturally through game theory and mechanism design. In addition, we suggest that simulation has a role in the study of complex multiagent processes and systems, aiding modelling, analysis, and evaluation [17, 7]. A broader question is whether agent technology can be used to build automated, semi-automated, or decision-aided systems that are more reliable than processes carried out solely by human actors.

## 4 Research Outlook

We conclude by enumerating relevant research questions, adapted from the Call for Papers for the CARE workshop:

- How do we design markets that hinder collusion?
- What interventions and incentives can disincentivize negative collaboration?
- How do we enforce prohibitions on illicit joint agreements and contracts?
- How do we build agent systems that work efficiently in partially-regulated environments where negative collaboration is not necessarily prohibited?
- How do we build systems or mechanisms robust to unreliable or non-conformant collaborators, and to colluding groups of agents?
- How do organizational structures influence the negotiation of agents and collusive behaviour?
- How can lessons learned in game theoretic computation inform mitigation of collusion?

---

<sup>5</sup> To ‘disincentivize’ is standard procedure in market programming, in the sense that protocols should be robust to speculation, i.e., speculation being unwarranted in every practical case by any rational agent in the market.

**Acknowledgements.** Thanks are due to Magnus Boman, Tony Feghali, and F. Jordan Srour, and to the anonymous referees. This work was partially supported by University Research Board grant A88813 from the American University of Beirut.

## References

1. Cramton, P., Schwartz, J.A.: Collusive bidding: Lessons from the FCC spectrum auctions. *J. Regulatory Economics* 17, 229–252 (2000)
2. Desai, N., Narendra, N.C., Singh, M.P.: Checking correctness of business contracts via commitments. In: *Proc. AAMAS*. pp. 787–794. Estoril, Portugal (2008)
3. Dignum, V., Dignum, F., Osinga, S.A., Hofstede, G.J.: Normative, cultural and cognitive aspects of modelling policies. In: *Proc. Winter Simulation Conference*. pp. 720–732. Baltimore, MD (2010)
4. Dignum, V., Tranier, J., Dignum, F.: Simulation of intermediation using rich cognitive agents. *Simulation Modelling Practice and Theory* 18(10), 1526–1536 (2010)
5. Gal, Y., Kraus, S., Gelfand, M., Khashan, H., Salmon, E.: An adaptive agent for negotiating with people in different cultures. *ACM Transactions on Intelligent Systems and Technology* (to appear)
6. Guttmann, C., Dignum, F., Georgeff, M. (eds.): *Collaborative Agents – REsearch and development (CARE 2009/2010)*, vol. LNAI 6066. Springer (2011), to appear
7. Harb, H., Srour, F.J., Yorke-Smith, N.: A case study in model selection for policy engineering: Simulating maritime customs. In: *Proc. AAMAS’11 Workshop on Agent-based Modeling for Policy Engineering*. Taipei, Taiwan (2011)
8. Hors, I.: Fighting corruption in customs administration: What can we learn from recent experiences? OECD Development Centre Working Paper 175 (2001)
9. Jurca, R., Faltings, B.: Mechanisms for making crowds truthful. *J. Artificial Intelligence Research* 34, 209–253 (2009)
10. Karlsson, M., Ygge, F., Andersson, A.: Market-based approaches to optimization. *Computational Intelligence* 23(1), 92–109 (2007)
11. Klitgaard, R., MacLean-Abaroa, R., Parris, H.L.: *Corrupt Cities: A Practical Guide to Cure and Prevention*. ICS Press, Oakland, CA (2000)
12. Maritime Knowledge Centre, International Maritime Organization: International shipping and world trade: Facts and figures. [www.imo.org](http://www.imo.org) (2009)
13. McGee, M.K.: Covisint and AT&T enter health care exchange market. *InformationWeek* (25 Feb 2008), [www.informationweek.com/news/software/soa\\_webservices/showArticle.jhtml?articleID=206801143](http://www.informationweek.com/news/software/soa_webservices/showArticle.jhtml?articleID=206801143)
14. Mercuri, R.T., Camp, L.J.: The code of elections. *Communications of ACM* 47, 52–57 (2004)
15. Shelat, A.: Collusion-free protocols. In: *Proc. Behavioral and Quantitative Game Theory: Conf. on Future Directions*. pp. 91:1–91:1. Newport Beach, CA (2010)
16. Srour, F.J., Harb, H., Yorke-Smith, N.: Maritime customs negotiation with corrupt agents. In: *INFORMS Annual Meeting*. Austin, TX (2010)
17. Tesfatsion, L.: Agent-based computational economics: Growing economies from the bottom up. *Artificial Life* 8, 55–82 (2002)
18. Transparency International: *The Global Corruption Report 2009*. [www.transparency.org/publications/gcr](http://www.transparency.org/publications/gcr) (2009)
19. Zhou, X., Zheng, H.: Breaking bidder collusion in large-scale spectrum auctions. In: *Proc. ACM Intl. Symposium on Mobile Ad Hoc Networking and Computing*. pp. 121–130. Chicago, IL (2010)